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Foreword

The present volume contains a collection of papers presented at the 21st annual meeting "Sinn und Bedeutung" of the Gesellschaft für Semantik, which was held at the University of Edinburgh on September 4th–6th, 2016.

239 abstracts were submitted to SuB21; of the 72 talks and 30 posters on the program, 82 were elaborated into the papers in this collection.

The editors of the present volume would like to thank the authors for their contributions and all the anonymous reviewers for their collaboration. We also wish to thank Ede Zimmermann for patient and helpful advice; our fellow organizers Nikolas Gisborne and Marieke Schouwstra; our administrative team Julie Anderson, Steven McGauley, Sylvia Rennie, and Davy Wilkinson for invaluable help in the background; our student volunteers Michela Bonfieni, Kiera Davidson, Jim Donaldson, Sorcha Gilroy, E Jamieson, and Schuyler Laparle; the invited speakers Nicholas Asher, Sigrid Beck, and Peter Lasersohn; Sarah Meyer Truswell for designing the front cover; and everyone else who contributed to the success of the conference.

Edinburgh, September 2018

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Van Benthem's problem, exhaustification, and distributivity[1]

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Abstract. We discuss the problem of deriving upper-bounded meanings of **few**, **fewer than**, and related expressions, in treatments where they are taken to denote predicates of individuals. In such analyses, the determiner-like uses of these expressions are derived by existentially-closing their predicate denotations, but this is known to give rise to problems (van Benthem, 1986). We show that the needed upper bound can be derived by applying an exhaustification operator above existential closure. Crucially, this exhaustification operator is insensitive to the distributive properties of the predicates in the sentence, an assumption that we see as consistent with recent work supporting the blindness view of implicatures (Fox and Hackl, 2006; Magri, 2009). We also discuss some similarities and differences between our analysis and Buccola and Spector's (2016) maximality-based approach.

Keywords: Modified numerals, exhaustification, distributivity, maximality.

1. Introduction

It is known that the expressions **many** and **few**, along with morphosyntactic derivatives like **fewer than 3**, show adjectival as well as determiner-like uses. Examples are shown in (1).

(1) a. The many/few people who smiled were smiling broadly
b. (The) people who smiled were many/few
c. Many/few people smiled

It is also known that, in the case of **many**, these multiple uses can be accommodated in a uniformly adjectival treatment, if it is complemented with an operation of Existential Closure (EC). The idea would be that **many** denotes a predicate of individuals, holding of those plural entities that reach a contextually-set cardinality, and in cases like (1c) where **many** behaves like a determiner, the truth conditions result from existentially closing the predicate.

But (as is also known), EC generates problematic results in the case of **few**. Suppose that, analogously to **many**, **few** denotes a predicate of (plural) individuals, holding of just those pluralities that fall below a certain cardinality threshold. If the determiner-like reading is to be derived from EC, the resulting truth conditions will require that some 'small' plurality exist that has whatever other properties appear in the given sentence. But these predicted conditions are inaccurate, because (i) they incorrectly require existence, and (ii) they fail to set a desired upper bound. The unwanted existence requirement comes from EC: under EC, and following standard ontological assumptions, sentences like (1c) where **few** behaves like a determiner cannot be true unless the given predicate(s) are verified by some *existing* plurality. But as is generally agreed in the literature, such sentences are intuitively true even if no individuals

[1]We are grateful to Brian Buccola, Danny Fox, Rick Nouwen, Benjamin Spector, Eytan Zweig, and the audience at the 21st *Sinn und Bedeutung* in the University of Edinburgh. All errors are our own.

verify the predicate(s).[2] The second problem, the upper bound problem, is that the existence of small pluralities is compatible with the existence of larger ones; any large plurality of e.g. smiling people will have a small sub-plurality that satisfies the condition of fewness, which means that scenarios where a great number of people smiled will be predicted (incorrectly) to verify the truth conditions of **few people smiled**.

In this paper we will have little to say about the existence problem (problem (i) above). Our focus will be on the upper bound problem, known in current literature as van Benthem's problem (van Benthem 1986). We propose an exhaustification mechanism that correctly sets the needed upper bound, thus circumventing van Benthem's problem. The key detail in the proposal is that exhaustification applies without any sensitivity to the distributive/collective properties of the predicates appearing in the given construction. This assumption builds on recent work promoting the 'blindness' view of implicatures. We explain the details of our proposal in Section 2, and discuss some of its consequences in Section 3. In Section 4 we turn our attention to Buccola and Spector's (2016) discussion of these issues, and provide a brief (and at the moment inconclusive) comparison between one of their proposals and ours. In the remaining parts of the current section, we elaborate on the details of van Benthem's problem, taking note in particular of how it interacts with distributive predicates, and with non-distributive ones.

1.1. Van Benthem's problem and distributive/non-distributive predicates

To keep things simple we will assume that EC is the product of an unpronounced existential determiner, Ǝ, defined in (2).

(2) $[\![\text{Ǝ}]\!] = [\lambda P_{\langle e,t\rangle} \,.\, \lambda Q_{\langle e,t\rangle} \,.\, \exists x(P(x){=}Q(x){=}1)]$

We will also focus our attention on comparative phrases like **more than 4** and **fewer than 4**, instead of **many** and **few**, in order to sidestep the vagueness of the latter's semantics. To keep the presentation simple we assume that **more than 4** and **fewer then 4** denote predicates of individuals:[3]

(3) a. $[\![\textbf{more than 4}]\!] = [\lambda x_e \,.\, |x| > 4]$
b. $[\![\textbf{fewer than 4}]\!] = [\lambda x_e \,.\, |x| < 4]$

If predicates of type $\langle e,t\rangle$ can compose by Predicate Modification, then **more/fewer than 4 people** will denote another set/predicate of plural entities, namely entities of size greater (or less) than four that consist of people. Applying Ǝ to these predicates will produce an existential quantifier that maps a given predicate Q to True iff Q holds of some plurality of people that contains more than (or less than) four atoms. The LFs and truth conditions for the two sentences are shown below.

[2] Though sentences like **few students smiled** license existence inferences by default, the inference is thought to be extra-semantic, given its disappearance in DE contexts, and cancellability in **in fact** continuations.

[3] As far as we can see, this assumption can be replaced with a more complex syntax/semantics for comparatives without affecting the tenability of the overall proposal. See Alxatib (2013), Chapter 7.

(4) a. **[[∃ more than 4 people] smiled]**
b. $\exists x(\llbracket\textbf{people}\rrbracket(x)=1\ \&\ |x|>4\ \&\ \llbracket\textbf{smiled}\rrbracket(x)=1)$

(5) a. **[[∃ fewer than 4 people] smiled]**
b. $\exists x(\llbracket\textbf{people}\rrbracket(x)=1\ \&\ |x|<4\ \&\ \llbracket\textbf{smiled}\rrbracket(x)=1)$

As remarked above, the conditions in (5b) are less informative than desired: they hold even in situations where more than four people smiled, because if (say) five people smiled, there is guaranteed to be a smiling *sub*-group whose size is lower than four. In fact, if we look more closely we can see that the truth conditions of (5a) are identical to those that result when **4** is replaced with any other numeral. To see this, consider the minimally different **fewer than 5 people smiled**:

(6) a. **[[∃ fewer than 5 people] smiled]**
b. $\exists x(\llbracket\textbf{people}\rrbracket(x)=1\ \&\ |x|<5\ \&\ \llbracket\textbf{smiled}\rrbracket(x)=1)$

If the conditions in (5b) hold, then there is a smiling plurality of size less than four, and therefore less than five, which means that (5a) entails (6a). Conversely, if (6b) holds, i.e. if there is a plurality of smilers of size less than five, then by the distributivity of the predicate **smiled** it follows that there is a smiling sub-plurality of size less than four. Therefore, (6a) entails (5a). This makes (5a) and (6a) equivalent, and the numeral in them semantically irrelevant.

At this point it is crucial to highlight the role of distributivity, of the predicate **smiled** in this case, in making (6)/(5) equivalent. In the case of non-distributive predicates like **lifted the piano (together)**, only one of the two entailments noted above will hold. Consider the LFs and truth conditions in (7) and (8).

(7) a. **[[∃ fewer than 4 people] lifted the piano]**
b. $\exists x(\llbracket\textbf{people}\rrbracket(x)=1\ \&\ |x|<4\ \&\ \llbracket\textbf{lifted the piano}\rrbracket(x)=1)$

(8) a. **[[∃ fewer than 5 people] lifted the piano]**
b. $\exists x(\llbracket\textbf{people}\rrbracket(x)=1\ \&\ |x|<5\ \&\ \llbracket\textbf{lifted the piano}\rrbracket(x)=1)$

(7b) says that there is a person-plurality of size less than four that lifted the piano. When this holds, the conditions in (8b) must also hold; if there is a piano-lifting plurality of size less than four, then that same plurality makes it true that there is one of size less than five. (7a) therefore entails (8a), in parallel to the entailment from (5a) to (6a). But the reverse entailment does not hold here; if there is a piano-lifting group of size less than five (=(8b)), it does not follow that there is one of size less than four (=(7b)): Suppose exactly four people lifted the piano together. The size of this group falls below five, but not below four, and there is no guarantee that some sub-group of the four lifters also lifted the piano, because the lifting is true of them collectively, not individually.

We therefore see that van Benthem's problem (the problem of the upper bound) causes numerals to be semantically redundant in the case of distributive predicates, though as we pointed out, this is not the case for non-distributive predicates. We will now explain what this redundancy means for attempts to derive the upper bound by pragmatic strengthening (or exhaustification): because (under distributivity) all alternatives of the form **fewer than n** are equivalent, there will be no way of selecting the right alternatives for exhaustification, and of using those alternatives to generate the desired upper bound at the correct **n**. We expand on this next. From this point on, we will write '$\exists$>**few** constructions' to refer to sentences where EC outscopes **few** and similar expressions. We also write 'distributive/non-distributive $\exists$>**few** constructions' to refer to $\exists$>**few** constructions that contain (or do not contain) distributive predicates.

1.2. Van Benthem's problem and pragmatic strengthening?

Our current truth conditions for distributive $\exists$>**few** constructions only require existence, and appear to make no use of the numeral modified by **fewer than**.[4] But what if the truth conditions were complemented with the negation of other, more informative alternatives? In (Neo-) Gricean pragmatics, a sentence *S* that is uttered in a certain context licenses not only the inferences that result from its literal meaning, but also the inference that alternative sentences which (i) were not uttered, (ii) would have been as relevant in that context, and (iii) are stronger than *S*, are false. It may seem that pragmatic principles along these lines can be used to derive the upper bound of $\exists$>**few** sentences, but as we now explain, pragmatic strengthening of distributive $\exists$>**few** LFs is either vacuous, or excessive.

The first of these two outcomes results if the only relevant alternatives to an $\exists$>**few** sentence are those where the numeral/degree is substituted for another. In the case of our example (5a), repeated below as (9a), this assumption limits the alternatives to those in (9b).

(9) a. **[[$\exists$ fewer than 4 people] smiled]**
b. $\{$**[[$\exists$ fewer than 3 people] smiled]**,
[[$\exists$ fewer than 5 people] smiled],
[[$\exists$ fewer than 6 people] smiled], $\cdots\}$

The problem is that none of the alternatives in (9b) are stronger than (9a); they are all equivalent. This gives the strengthening mechanism nothing to negate (or 'exclude') in strengthening (9a), and leaves it vacuous.

Now, suppose we enrich our set of alternatives and add constructions of the form **[[n people] smiled]**, i.e. where **fewer than** is removed:

[4] We will return to the existence requirement in Section 4.

(10) a. **[[∃ fewer than 4 people] smiled]**
b. {**[[∃ fewer than 3 people] smiled]**,
[[∃ fewer than 5 people] smiled],
[[∃ fewer than 6 people] smiled],
c. **[[∃ 2 people] smiled]**,
[[∃ 3 people] smiled],
[[∃ 4 people] smiled],
[[∃ 5 people] smiled], $\cdots$}

Each alternative in (10c) requires that there be an **n**-sized plurality of smiling people, and hence they each asymmetrically entail the weak existence truth conditions of (10a). It follows, by the simple pragmatic recipe described above, that an utterance of (10a) will semantically require existence, and via pragmatic strengthening will imply that no group of four or five smilers exists—so far correctly—but also that no group of three smilers exists, and no group of two smilers exists. By nullfying the semantic contribution of the numeral in the original utterance, the strengthening mechanism described above will not help recover the correct upper bound, because there will be no way to correctly identify its location.

In the next section, we will present a modified strengthening mechanism that bypasses van Benthem's problem. We will first introduce the mechanism's two key components, Innocent Exclusion and blindness, and show how they interact to produce the correct upper bound for distributive ∃>**few** constructions. We will then discuss our predictions for non-distributive cases, and finally, compare our analysis to the analysis offered in Buccola and Spector (2016).

2. Reconsidering Pragmatic Strengthening

2.1. Innocent Excludability, Blindness, and Implicature Calculation

We will assume that the strengthened meaning of a sentence *S* is derived by applying an exhaustification operator Exh to the denotation of *S* (along the lines of Fox 2007a, following proposals by Groenendijk and Stokhof 1984; Krifka 1995; Landman 1998; van Rooy 2002). Exh may be viewed as a covert variant of **only**. Its semantics is defined below:

(11) $[\![\mathrm{Exh}]\!]^{w}(A_{\langle st,t\rangle})(p_{\langle s,t\rangle})=1$ iff $p(w)=1$ & $\forall q(q\in \textsc{excl}(p,A) \;\rightarrow\; q(w)=0)$

The exhaustification operator takes a proposition p, its 'prejacent', and a set of alternatives A, and asserts that p is true and that all its excludable alternatives (from A) are false. The set of excludable alternatives $\textsc{excl}(p,A)$ is a subset of A. Different versions of Exh proposed in the literature differ with respect to how this set of excludable alternatives is defined. One possibility is to define $\textsc{excl}(p,A)$ as that subset of A that contains all (and only) propositions that are not entailed by p:

(12) $\textsc{excl}(p,A) = \{q : q\in A \;\&\; p \not\models q\}$

But we will now show why (12) is problematic, and why (following Fox and others) we adopt the notion of 'Innocent Excludability' instead of it.

2.2. Innocent Excludability

It was argued in Sauerland (2004) that disjunctive constructions should have not only their conjunctive counterparts as alternatives, but also the disjuncts. This is based on cases like (13).

(13) John needs to talk to Mary or Sue.

(13) naturally implies that John does not need to talk to Mary specifically, nor to Sue. If this is to be derived as an implicature, then the mechanism that generates implicatures must have access to the alternatives seen in (14), where the disjunction is replaced with its disjuncts. The alternatives are shown together with the *conjunctive* alternative to (13), but in this example the conjunctive alternative will not play an important role.

(14) a. John needs to talk to Mary
b. John needs to talk to Sue
c. John needs to talk to Mary and Sue

Note that each of (14a) and (14b) is logically stronger than the original (13), which means that, if they are included in the set of alternatives, they will count as excludable by the definition in (12) and consequently be negated by the strengthening mechanism. Here, this seems to be a good result.[5] But in the case of unembedded disjunctions like (15), the same ingredients make strengthening contradictory.

(15) John saw Mary or Sue.

(16) a. John saw Mary.
b. John saw Sue.
c. John saw Mary and Sue.

Under the assumption that disjunction has its disjuncts among its alternatives, the application of Exh to (15) is predicted to assert (15) and negate both of (16a) and (16b) (in addition to negating (16c)). But this leads to the contradiction in (17):

(17) John saw Mary or Sue and he didn't see Mary and he didn't see Sue.

The conclusion from this result is that (12), our current definition of excludable alternatives, must be revised in a way that allows the alternatives in (14) to participate in strengthening (13), but blocks (16a–b) from participating in strengthening (15). The revision we adopt is Fox's (2007a), who defines excludability as 'innocent' excludability.

[5] Negating the conjunctive alternative in (14c) is vacuous here, since it follows from negating either of the disjuncts.

Our formulation of Innocent Excludability (IE) is the following: given a proposition p and a set of propositions A, the IE-alternatives ($\textsc{excl}(p,A)$) are those that remain in A after the *non-innocent* subsets of A are removed from A. The non-innocent sets, in turn, are those whose 'set-negation' contradicts p, and that have no proper subsets whose set-negation contradicts p. The set negation of a set A is the conjunction of the negations of A's elements. These definitions are summarized below:

(18) $\textsc{excl}(p,A) = A - \bigcup\{B : B \subseteq A \text{ and } B \text{ is non-innocent w.r.t. } p\}$
  a. B is non-innocent w.r.t. p iff (i) $B^{\neg} \vDash \neg p$, and
    (ii) $\neg\exists B'(B' \subset B \ \& \ B'^{\neg} \vDash \neg p)$.
  b. $B^{\neg} = \bigwedge\{\neg q : q \in B\}$

This revised definition of $\textsc{excl}$ in (18) successfully distinguishes the case of (13) from (15). Let us represent the disjunction in (15) as $p \vee q$, and its alternatives as p, q, and $p \wedge q$:

(19) $A = \{p, q, p \wedge q\}$

Now, given the definition in (18), what subsets of A are non-innocent with respect to $p \vee q$? It is clear that negating all of the propositions in A will jointly contradict the disjunctive $p \vee q$, so A itself satisfies condition (i) in (18a). But A fails condition (ii) in (18b) because there is a proper subset of A whose set negation also contradicts $p \vee q$. This is the set $\{p,q\}$. And because $\{p,q\}$ does *not* have proper subsets whose set negations contradict $p \vee q$, it follows that $\{p,q\}$ is non-innocent with respect to $p \vee q$. So, the set of IE-alternatives in A, given $p \vee q$, is the result of subtracting the non-innocent set $\{p,q\}$ from A:

(20) $\textsc{excl}(p \vee q, A) = A - \{p,q\} = \{p \wedge q\}$

It follows that strengthening $p \vee q$ given the set of alternatives A will not be contradictory, and will generate the inference that the conjunctive $p \wedge q$ is false.

Consider now the case of (13), where disjunction is embedded under a universal modal. Here we may represent (13) itself as $\Box(p \vee q)$, and its alternatives as $\Box p$, $\Box q$, and $\Box(p \wedge q)$:

(21) $A' = \{\Box p, \Box q, \Box(p \wedge q)\}$

It should be clear that negating all of the alternatives in A' does not contradict $\Box(p \vee q)$; the negation will merely require that not all accessible worlds be p-worlds, and not all accessible worlds be q-worlds. This is consistent with $\Box(p \vee q)$, because the modal base may consist of a mix of worlds, some being p-worlds and others being q-worlds. There are therefore no non-innocent sets within A' given $\Box(p \vee q)$,

(22) $\textsc{excl}(\Box(p \vee q), A') = A' - \{\} = A'$

and from this it follows that exhaustifying (13), given the set of alternatives in A', will generate the inference that each element in A' is false:

(23) $\text{Exh}(A', \Box(p \vee q)) = \Box(p \vee q)\ \&\ \neg\Box p\ \&\ \neg\Box q\ \&\ \neg\Box(p \wedge q)$

This concludes our introduction of Innocent Excludability. We now turn to the second of our two key ingredients, blindness.

2.3. Blindness

We take 'blindness' to be a property of semantic operators or mechanisms. When we say that an operator ***O*** is blind to some informational content, we mean that ***O*** applies without any sensitivity to that content, that is, that ***O*** applies to representations (e.g. syntactic ones) where that information is absent. Though our discussion of blindness will remain somewhat vague in this paper, we see Gajewski (2002) as an important reference for how the notion may be made more precise (see specifically Gajewski's definition of 'logical skeleton').

We know of two proposals in the literature on implicatures that appeal to blindness. In one, Fox and Hackl (2006), it is argued that implicature calculation (and calculation of focus semantics) is blind to whether the predicates appearing in the given sentence utilize a discrete or dense scale of measurement. The claim is that implicatures are derived from representations where all measurement scales are assumed to be dense (we will explain the argument briefly below). If right, this means that implicature calculation (and calculation of focus semantics) is insensitive to content that on the surface appears to be *lexical*. As we will see later, our own proposal is similar to Fox and Hackl's in this respect. In another proposal, Magri (2009), implicature calculation is argued to be blind to contextual/world knowledge. We will review Magri's argument after we summarize Fox and Hackl's, but we want to make it clear that we will not talk in detail about how either of these two accounts might interact with our own. Our intention is to use the two proposals as precedent for the hypothesis that exhaustification is blind.[6]

2.3.1. Fox and Hackl (2006)

A central question in Fox and Hackl (F&H) is why sentences like (24) do not give rise to 'exact' implicatures.

(24) John read more than 3 books
$\not\Rightarrow$ ¬(John read more than 4 books)

Assuming that (24) has an alternative where the numeral **3** is replaced with **4**, we expect the latter to participate in exhaustifying the meaning of (24), since **John read more than 4 books** is stronger than (24). But then we expect (24) to imply that John read more than three but not more than four books, i.e. exactly four books.[7] In their discussion of the problem, Fox and Hackl point out that this prediction is specific to cases where the relevant scale is *discrete*; if

[6]Readers familiar with Fox and Hackl in particular will no doubt wonder how the density hypothesis interacts with our own exhaustification mechanism. This is by no means a trivial question, but we leave it for later work.

[7]Note that this predictions hinges on the assumption that comparatives have other comparatives as alternatives. One could add constructions of the form **exactly n . . .** , and we would no longer predict comparatives to give rise to these exact inferences. This possibility was in fact proposed in Spector (2005), but argued against in Fox (2007b).

the scale of degrees were dense, then there will be some alternative whose negation contradicts the utterance itself. Take (25) as an example.

(25) John is taller than 6 ft.

Let us assume that (25) requires that John reach a degree of height d above six feet. Unlike the integer scale, the scale of height is intuitively dense, meaning that for any two degrees of height d_1 and d_2 there is a degree of height d_3 in between them. If (25) requires that John reach some height d above six feet, then by the density of the height scale there must exist some degree of height d' above six feet and below John's actual height d. Consider now the alternative in (26).

(26) John is taller than d'

Since d' is above 6 feet, it follows that (26) is stronger than (25), which means that in strengthening (25) the algorithm should negate (26). But negating (26) means that John is at most d'-tall, which makes him shorter than d, i.e. shorter than his assumed actual height. The consequence is that, no matter how tall John is assumed to be, there is always a degree of height just below his own (and above six feet) that can form a stronger comparative sentence than (25), and whose negation will contradict the semantic content of (25).[8] The broader consequence of this is that implicatures of comparatives are predicted to generate contradictions if the relevant scale of degrees is dense. Yet the absence of implicatures in comparatives appears to hold regardless of whether the scale is discrete, as in the case of (24), or dense, as in the case of (25). Given this, Fox and Hackl propose that the level of representation at which implicatures are calculated (as well as focus etc.) is one where all scales are dense. This is their Universal Density of Measurement hypothesis.

The proposal we borrow from Fox and Hackl is that implicature calculation is in some sense blind to information provided by neighboring lexical material. That is, implicature calculation seems to proceed as if some abstract representations replaced the elements that make up the given sentence. By masking the properties of the elements they stand in for, e.g. the discreteness of the counting scale in (24), the abstraction renders implicature calculation insensitive to information that would otherwise change its outcome.

2.3.2. Magri (2009)

Another empirical argument in favor of the blindness view was presented in Magri (2009).[9] Magri claims that the notion of entailment relevant for implicature calculation is *logical*, rather than contextual. His argument is based on the oddness of sentences like (27):

(27) Some Italians come from a warm country.

The argument is this. (27) is odd because the use of **some** triggers a scalar implicature that the alternative with the universal quantifier, **all Italians come from a warm country**, is false.

[8] See Gajewski (2009) for a discussion of how this interacts with innocent excludability.

[9] See also Magri (2011); Schlenker (2012); and Magri (to appear) for discussion.

This leads to the strengthened proposition that *some but not all* Italians come from a warm country, which contradicts our knowledge that all Italians come from the same country. But as Magri points out, this explanation works only if we assume that this piece of world knowledge is unavailable to implicature calculation. While the alternative **all Italians come from a warm country** is logically stronger than (27), the two sentences are *contextually* equivalent; knowing that all Italians come from the same country, if some Italians come from a warm country, then it must be the case that all of them do (and vice versa). If this information is factored into the implicature-calculating mechanism, the **all**-alternative would not be negated, because it is equivalent to (27), and the oddness would no longer be predicted. If, on the other hand, the mechanism was blind to world-knowledge, and was sensitive only to logical information, then exhaustification would apply, and produce the detected oddness of (27).[10]

In what follows, we will attempt to exhaustify our $\exists$>**few** structure again, but with the blindness hypothesis and Innocent Excludability in mind. We will show that if the distributivity of the given predicate is hidden from the exhaustification mechanism—in parallel to how scale discreteness is hidden, in Fox and Hackl's proposal—we predict that the upper bound be placed correctly, thus overcoming the challenge of van Benthem's problem.

2.4. Exhaustification revisited

Consider once again the $\exists$>**few** LF in (28),

(28) **[[$\exists$ fewer than 4 people] smiled]**

And consider the alternatives below:

(29) a. {**$\exists$ fewer than 2 people smiled**,
$\exists$ fewer than 3 people smiled,
b. **$\exists$ fewer than 5 people smiled**,
$\exists$ fewer than 6 people smiled, $\cdots$
c. **$\exists$ 2 people smiled**,
$\exists$ 3 people smiled,
d. **$\exists$ 4 people smiled**,
$\exists$ 5 people smiled,
$\exists$ 6 people smiled, $\cdots$}

As we saw in Section 1.2, the distributivity of the verb **smiled** makes each of the alternatives in (29a–b) equivalent to (28), so negating any of them individually will contradict (28). This means that each alternative in (29a–b) makes its own *singleton* non-innocent set, since by definition, a set is non-innocent if its set-negation contradicts the utterance, and if it has no proper subset whose set-negation contradicts the utterance. The alternatives in (29a–b) are therefore not innocently excludable.

[10] As Magri himself notes, the success of his analysis requires that (27) be *obligatorily* exhaustified, since the oddness of the sentence would otherwise not be predicted. The reader is referred to the original paper for details.

What about the alternatives in (29c–d)? As we showed in Section 1.2, negating these together does not contradict the truth conditions of (28), so they are all predicted to be innocently excludable. It follows that exhaustifying (28) with respect to the alternatives in (29) will produce an excessively low upper bound:

(30) $\mathrm{Exh}((29),(28))=1$ iff $\exists x([\![\textbf{people}]\!](x)=1\ \&\ |x|<4\ \&\ [\![\textbf{smiled}]\!](x)=1)\ \&$
$\neg\exists x([\![\textbf{people}]\!](x)=1\ \&\ |x|\geq 2\ \&\ [\![\textbf{smiled}]\!](x)=1)\ \&$
$\neg\exists x([\![\textbf{people}]\!](x)=1\ \&\ |x|\geq 3\ \&\ [\![\textbf{smiled}]\!](x)=1)\ \&\cdots$

But recall also that the equivalence of (29a–b) and (28) does not hold when **smiled** is replaced with a collective predicate. In those cases, the alternatives with the lower numeral asymmetrically entail those with the higher numeral. If there exists a piano-lifting group of size less than four, then there exists a piano-lifting group of size less than five, namely the same one, but the reverse does not hold: if there is a lifting group of size less than five, it does not follow that there is one of size less than four.

Now suppose that, by blindness, the exhaustification mechanism were insensitive to the lexical properties of the verb. Then the grouping of alternatives into non-innocent sets will change, and consequently change the contents of the (innocently) excludable set. Let us repeat (29) and (30), but abstract away from the NP/VP:

(31) **[[∃ fewer than 4 NP] VP]**

(32) a. {**∃ fewer than 2 NP VP**,
∃ fewer than 3 NP VP,
b. **∃ fewer than 5 NP VP**,
∃ fewer than 6 NP VP, $\cdots$
c. **∃ 2 NP VP**,
∃ 3 NP VP,
d. **∃ 4 NP VP**,
∃ 5 NP VP,
∃ 6 NP VP, $\cdots$}

We can immediately see that the alternatives in (32b) are non-innocent, because each of them is individually weaker than (31), and therefore comprises a singleton non-innocent set of its own. The alternatives in (32a) are stronger than (31), but they are not innocently excludable because they form non-innocent sets with alternatives in (32c). As an example, take the first alternative in (32a) and the first alternative in (32c). Negating the former amounts to saying that there are no groups (of NPs that VP) of size less than 2, which means that the size of VPing NP groups is 2 or greater. This contradicts the negation of the first alternative in (32c), which says that there are no groups of VPing NPs of size 2 or more. Note that, by themselves, each of these alternatives can be negated consistently with (31), so on their own, they do not form non-innocent sets with respect to (31).

More generally, then, for any numeral (or degree) d lower than 4, there is a non-innocent set that contains the alternatives **[Ǝ fewer than *d* NP VP]** together with the alternative **[Ǝ *d* NP VP]**. Any set containing just these two sentence is non-innocent, because its set negation is contradictory and therefore inconsistent with (31).

What about the alternatives in (32d)? It may appear that each of these can be paired with an alternative from (32b) into a non-innocent set. But in fact, these sets have non-innocent proper subsets: remember that each alternative in (32b) individually forms a singleton non-innocent set, so pairing it with an alternative from (32d) will not produce a non-innocent set.

It follows, then, that the excludable alternatives from (32) are the ones in (32d), and negating these produces the desired upper bound.

(33) $$\begin{aligned}\text{Exh}((32),(31)){=}1 \text{ iff } & \exists x([\![\mathbf{NP}]\!](x){=}1 \;\&\; |x|{<}4 \;\&\; [\![\mathbf{VP}]\!](x){=}1) \;\& \\ & \neg\exists x([\![\mathbf{NP}]\!](x){=}1 \;\&\; |x|{\geq}4 \;\&\; [\![\mathbf{VP}]\!](x){=}1) \;\& \\ & \neg\exists x([\![\mathbf{NP}]\!](x){=}1 \;\&\; |x|{\geq}5 \;\&\; [\![\mathbf{VP}]\!](x){=}1) \;\& \cdots\end{aligned}$$

3. Discussion and consequences

In a nutshell, our proposal derives the upper bound of Ǝ>**few** constructions not from their literal semantics, but from an exhaustification mechanism that negates whatever is excludable from the set of alternatives. In Section 2 we showed that, in order for the exhaustification mechanism to produce the correct upper bound, the entailment relations it 'sees' between the alternatives must be independent of whether the predicates in those alternatives are distributive or collective. We pointed to findings in the literature on implicatures, notably Fox and Hackl (2006) and Magri (2009), that suggest that exhaustification is blind to lexical/contextual information.

But the proposal brings many questions with it. First, it is known that implicatures are often cancellable, so if an implicature-generating mechanism is responsible for the upper bound in the sentences that concern us, why is it that the upper bound is intuitively obligatory?

Our answer to this is that, in the case of distributive predicates, lack of exhaustification produces underinformative truth conditions. We make this precise and borrow Buccola and Spector's Pragmatic Economy Constraint:

(34) **Pragmatic economy constraint (Buccola and Spector, 2016)**:
An LF ϕ containing a numeral n is infelicitous if, for some m distinct from n, ϕ is truth-conditionally equivalent to $\phi[n \rightarrow m]$ (the result of substituting m for n in ϕ).

We will look more closely at Buccola and Spector's proposal in the next section. At the moment we can simply point out that (34) is used by them to get around a similar problem to ours: why is exhaustification (or, on their account, maximality) obligatory? The effect of (34) is to require that numerals make a truth conditional difference. As we saw in Section 1.2, unexhaustified Ǝ>**few** constructions have the same truth conditions regardless of the numeral that appears in them, and because of this, they are ruled out by the economy constraint in (34). On the other hand, exhaustifying $\exists$>**few** constructions (blindly) retrieves the semantic import of the numeral, and thus satisfies (34).

But now we face a second question. If exhaustification is made obligatory because of a filter against uninformative numerals, we predict that exhaustification be *optional* in *non-distributive* $\exists$>**few** sentences. The reason is simply that, as we saw in Section 1.2, changing the numeral in non-distributive $\exists$>**few** constructions *does* change the truth conditions, so there is no reason yet to favor either of the exhaustified or unexhaustified parses of (35):

(35) Fewer than 4 people lifted the piano (together).

Interestingly, sentences like (35) do not intuitively place an upper bound in the same way as distributive $\exists$>**few** examples. As Buccola and Spector point out, (35) requires only that *some* group of lifters reach a size below four; the sentence is still true if the piano was lifted by some other group of size five, six, etc. This reported judgment fits the prediction of the current proposal, which permits unexhaustified parses of (35) given that the numeral in it is non-trivial. But importantly, the proposal as it stands also allows exhaustified parses of non-distributive $\exists$>**few** structures. So we currently predict (35) to also have upper-bounded readings. We leave this issue to future work.

Another important problem that we have set aside so far is the existence prediction of EC. The predicted truth conditions of $\exists$>**few** constructions, whether exhaustified or not, require that some *existing* plurality verify the predicates appearing in the sentence. We do not have a solution to this problem yet, but we will say more about it after we discuss Buccola and Spector's account, to which we now turn.

4. Maximality: Buccola and Spector (2016)

We must make it clear that our review of Buccola and Spector (B&S) is by no means representative of the many ideas they discuss. Our attention will be restricted to their syntactic maximality account (SMax) of modified numerals. Once we go over the basics of the account, we offer a brief comparison between it and our own proposal. As announced in the introduction, the comparison will be inconclusive, but it will highlight an advantage of B&S that has to do with the existence inference discussed earlier.

4.1. Syntactic Maximality (SMax)

The ingredients of B&S's SMax account are the following. First, expressions like **fewer than 4** denote generalized quantifiers (GQs) over degrees (type $\langle dt, t\rangle$) rather than predicates of individuals. Second, nodes that denote degrees (type d) can undergo two type-shifting operations, which we represent syntactically. One, IsCard, takes a degree d and returns a predicate of (plural) individuals. The predicate holds of individuals whose size equals d. The other, IsMax, takes a degree d and returns a GQ over degrees. The GQ holds of a set of degrees provided that its maximal element is d. The definitions are shown below:

(36) a. $[\![\textbf{fewer than 4}]\!] = [\lambda D_{\langle d,t\rangle} \,.\, \exists d(d{<}4 \;\&\; D(d){=}1)]$
b. $[\![\textbf{I}\textsc{s}\textbf{C}\textsc{ard}]\!](d) = [\lambda x_e \,.\, |x|{=}d]$
c. $[\![\textbf{I}\textsc{s}\textbf{M}\textsc{ax}]\!](d) = [\lambda D_{\langle d,t\rangle} \,.\, \max(D){=}d]$

On B&S's account, a sentence like (37) can have two possible LFs. In one LF, the phrase **fewer than 4** undergoes QR and binds a trace of type *d* in its base position. The trace is shifted by ISCARD into a predicate of individuals, and the result is composed with other predicates ultimately closed by an EC operation.

(37) **Fewer than 4 people smiled**

(38) **[fewer than 4] [λd [[$\exists$ [ISCARD(d) people]] smiled]]**

With the dislocated modified numeral scoping above EC, the resulting truth conditions require that some degree d below 4 exist, and that some smiling plurality be of size d. These are the same (uninformative) truth conditions as those predicted on our account (without exhaustification):

(39) $[\![(38)]\!]{=}1$ iff $\exists d(d{<}4 \;\&\; \exists x(|x|{=}d \;\&\; [\![\textbf{people}]\!](x){=}1 \;\&\; [\![\textbf{smiled}]\!](x){=}1))$
$={1}$ iff $\exists x(|x|{<}4 \;\&\; [\![\textbf{people}]\!](x){=}1 \;\&\; [\![\textbf{smiled}]\!](x){=}1)$

In another LF of (37) the phrase **fewer than 4** is moved further, and binds a trace that undergoes shifting by ISMAX.

(40) **[fewer than 4] [$\lambda d'$ [ISMAX(d')] λd [[$\exists$ [ISCARD(d) people]] smiled]]**

The truth conditions of this LF require that, for some degree d below 4, the maximal size of existing smiling groups equal d. This is the same as saying that the maximal size of existing smiling groups fall below 4, which matches the intuited upper-bounded reading of the sentence.

(41) $[\![(40)]\!]{=}1$ iff $\exists d(d{<}4 \;\&\; \max\{d' : \exists x(|x|{=}d' \;\&\; [\![\textbf{ppl}]\!](x){=}1 \;\&\; [\![\textbf{smiled}]\!](x){=}1)\}{=}d)$
$={1}$ iff $\max\{d : \exists x(|x|{=}d \;\&\; [\![\textbf{ppl}]\!](x){=}1 \;\&\; [\![\textbf{smiled}]\!](x){=}1)\}{<}4$

The choice between LFs (38) and (40), for sentence (37), is based on the Pragmatic Economy Constraint (PEC) that we cited earlier. Recall that the constraint blocks LFs that contain uninformative numerals. In (38), the numeral is uninformative because of the distributivity of **smiled** (see discussion in Section 1.2), but in (40), changing the numeral clearly changes the truth conditions. By the PEC, then, only the latter LF can be associated with (37), which means that upper-bounded readings are obligatory when distributive predicates are used. In the case of non-distributive predicates, however, 'non-maximal' LFs incur no violation of the PEC, because their truth conditions depend crucially on the numeral. It follows that sentences like (42) can be interpreted without an upper bound—LF (43)—or with an upper bound—LF (45).

(42) **Fewer than 4 people lifted the piano (together)**

(43) **[fewer than 4] [λd [[Ǝ [ISCARD(d) people]] lifted the piano]]**

(44) $[\![(43)]\!]=1$ iff $\exists d(d<4$ & $\exists x(|x|=d$ & $[\![\textbf{people}]\!](x)=1$ & $[\![\textbf{smiled}]\!](x)=1))$
$=1$ iff $\exists x(|x|<4$ & $[\![\textbf{people}]\!](x)=1$ & $[\![\textbf{lifted...}]\!](x)=1)$

(45) **[fewer than 4] [$\lambda d'$ [ISMAX(d')] λd [[Ǝ [ISCARD(d) people]] lifted...]]**

(46) $[\![(45)]\!]=1$ iff $\exists d(d<4$ & $\max\{d' : \exists x(|x|=d'$ & $[\![\textbf{ppl}]\!](x)=1$ & $[\![\textbf{lifted...}]\!](x)=1)\}=d)$
$=1$ iff $\max\{d : \exists x(|x|=d$ & $[\![\textbf{ppl}]\!](x)=1$ & $[\![\textbf{lifted...}]\!](x)=1)\}<4$

4.2. A comparison: Exhaustification or maximality?

As we said earlier, we cannot comprehensively compare our proposal to that of B&S. Nevertheless, we can take note of some features that the two accounts have in common, and other features that distinguish them. We leave a more detailed assessment to future investigation.

One common ingredient to B&S and the current proposal is the reliance on the PEC, and the resulting prediction that, with non-distributive predicates, upper-bounded readings are *permitted but not obligatory*. In our account, this is because unexhaustified parses are not blocked by the PEC in non-distributive Ǝ>**few** LFs; in B&S, it is because the PEC permits both maximal as well as non-maximal LFs. Whether or not this prediction fits the facts remains to be seen, but it appears that in this respect the two accounts are similar.[11] The proposals are also alike in deriving the upper bound from sources that are external to the modified numeral itself. In our account, the source of the upper bound is the (blind) exhaustification operator, while in B&S it is the ISMAX shift operation.

But there are differences. Consider first the existence inference mentioned in Section 3. On our proposal the inference results from existentially closing the predicate **fewer than 4**, but importantly, the inference remains even when the LF is (blindly) exhaustified. We therefore predict that upper-bounded readings still require existence, and that sentences like (37) be *false* in situations where no one smiled. We see this as a disadvantage of our account, and an advantage of B&S's, where applying ISMAX above ISCARD effectively removes the requirement of existence.[12]

There is, however, a possible amendment to exhaustification that deserves further research, which involves adding null individuals to the domain of entities. At the moment we cannot present a concrete version of this idea, and leave it to future development (see Landman 2004, and also B&S's maximal-informativity proposals in their Section 8). If such an analysis can be formulated, it may come with different predictions from B&S's SMax proposal, which es-

[11] B&S discuss cases where collective predicates take upper-bounded readings, citing personal communication with Philippe Schlenker. See their Section 7.

[12] It must be noted that removing the existence inference in B&S depends on defining max so that it returns the degree 0 when its input is the empty set. In situations where no one smiled, there are no degrees in the set $\{d : \exists x(|x|=d$ & $[\![\textbf{ppl}]\!](x)=1$ & $[\![\textbf{smiled}]\!](x)=1)\}$, and hence no maximal degree that can inform the semantics of ISMAX. To get around this, it must be explicitly stated that $\max\{\}=0$.

sentially correlates non-existence with upper-boundedness, since the two come together from applying ISMAX.

5. Conclusions

We discussed a problem that arises with the interpretation of expressions **few** and **fewer than 3** in certain environments. The problem can be described as follows. When combined with distributive predicates, those expressions intuitively impose an upper bound. However, assuming the adjectival semantics for **few** and deriving its quantificational meaning through EC, sentences with **few** are predicted to have uninformative truth conditions. We showed also that the needed upper bound cannot result from standard pragmatic strengthening mechanisms.

We proposed a modified strengthening mechanism that can derive the correct upper bound. The key properties of the proposed mechanism are (i) its insensitivity to information about distributivity, and (ii) innocent exclusion (Fox, 2007a). Our proposal was compared to Buccola and Spector's maximality-based account. As we pointed out, the comparison is incomplete and requires further investigation.

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Unifying the canonical, historical, and play-by-play present[1]

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Abstract. While the present tense is typically taken to index the reference time to the time of utterance, such a restriction cannot capture noncanonical uses of the present in English, such as the historical present or play-by-play present. We adopt a bicontextual semantics for present tense, in which the two time coordinates are mediated by pragmatics, allowing us to bring canonical, narrative, and play-by-play uses under a single denotation. Moreover, we show that such a treatment can also capture the novel observation that the historical use of the present tense can "anchor" the past perfect, while its other two uses cannot.

Keywords: tense, aspect, discourse structure, contextualism

The present tense in English has, in its canonical use, two properties that seem reasonably clear. First, it exhibits Utterance Indexicality: the present tense is used to describe eventualities that are simultaneous with the time of utterance. Second, it exhibits — unlike, say, German — what we might call Stativity: the present tense is only compatible with stative predicates, including derived ones (e.g., habituals).

(1) a. Susan **owns** the farm. *stative*
b. # Mary **reads** the newspaper.
Intended: 'Mary is reading the newspaper now.' *accomplishment*
c. # James **plays** the violin.
Intended: 'James is playing the violin now.' *activity*
(Smith, 1997: 111)

There are, however, two uses of the present tense, often conflated (e.g., Smith 1997: 111), which run counter to this orthodoxy: the *play-by-play* present and the *historical* present.[2]

(2) *Play-by-play present*
(USA vs. New Zealand, 2015 Women's Soccer Friendlies)
Commentator: Wambach **leads** it back and now Krieger **has** it. Tobin Heath **goes** far.
(http://www.youtube.com/watch?v=Kqe9n7zvnnw, 1:40:55)

(3) *Historical present*
I couldn't believe it! Just as we arrived, up **comes** Ben and **slaps** me on the back as if we're life-long friends. "Come on, old pal," he **says**, "Let me buy you a drink!" I'm telling you, I nearly fainted on the spot. (Quirk et al., 1985: 181)

Neither of these noncanonical uses exhibits Stativity: both are quite congenial with nonstative predicates. The historical use, in addition, does not exhibit Utterance Indexicality.

[1]We are grateful to audiences at Sinn und Bedeutung and the University of Arizona for their helpful comments and questions.

[2]In addition to these, there are headline, futurate, and performative uses of the present. These all violate Stativity, while the first two also violate Utterance Indexicality. We return to this issue in the conclusion.

We propose a unified semantics for the present tense in English that accounts for the properties of these two uses and the canonical present. There have been some previous attempts to derive one or the other of the noncanonical uses with customized solutions (Smith 1997: 185; Schlenker 2004; Eckardt 2015). We aim for a general theory that takes advantage of two pieces of off-the-shelf technology: i) a bicontextual semantics for tense (Sharvit, 2004, 2008), and ii) a version of Kamp and Reyle's (1993) semantics for the past perfect.

Our invocation of the past perfect comes from an apparently hitherto unnoticed contrast between the play-by-play and historical uses. The play-by-play present cannot "anchor" the past pefect—that is, it cannot describe an event which the past perfect locates another event anterior to, as shown in (4a). But the historical present can, as shown in (5a).

(4) *Play-by-play present*
Commentator: Federer serves. It's long. He looks at the line. He yells in protest.
a. # The judge **had called** a fault.
b. The judge **has called** a fault.
c. The judge **called** a fault.

(5) *Historical present*
Rumors of Berlusconi's crimes swirl. His advisors confront him. He scoffs.
a. He **had paid** off the prostitute for her silence already.
b. He **has paid** off the prostitute for her silence already.
c. He **paid** off the prostitute for her silence already.

In either of these uses, the present tense can, by contrast, be used to anchor the present perfect (4b, 5b) or simple past (4c, 5c).

Specifically, we propose that the present tense is indexical to the time of a *context of assessment* (Sharvit, 2004, 2008), which can be pragmatically distinct from the speech time, a coordinate of the *context of utterance* (cf. Schlenker 2004). When the present tense is unmoored from the speech time, Utterance Indexicality and Stativity are simultaneously lifted. In turn, we argue that the contrast in (4) and (5) reflects an additional restriction of the past perfect, namely that it is indexical to both the context of assessment and the context of utterance, cf. Kamp and Reyle (1993: 598). Together, these two ingredients correctly predict that, under the pragmatic norms governing the play-by-play present, the past perfect is inadmissable.

1. The canonical present

Both properties of the canonical present follow from standard treatments, where the present tense is sensitive to the time of the utterance context (u). A familar encoding of this is given in (6) within a referential theory of tense.

(6) *A standard treatment of the present tense*
$[\![\text{PRES}_i]\!]^{u,g}$ is defined iff $g(i) \subseteq \text{TIME}(u)$. When defined, $[\![\text{PRES}_i]\!]^{u,g} = g(i)$

Utterance Indexicality follows straightforwardly. Stativity also follows with three assumptions:

- The utterance time, TIME(u), contains the reference time, $g(i)$, as opposed to being contained in it (Kratzer, 1998: 101) or simply overlapping it (von Stechow, 1995: 365).

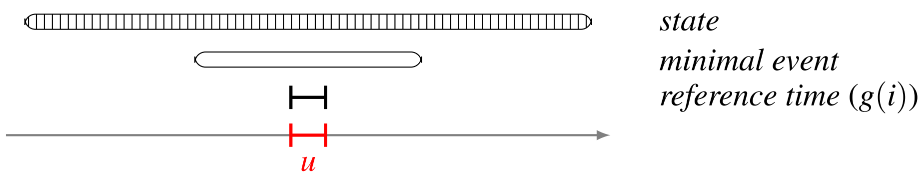
- Without progressive morphology, the present tense in English conveys perfective aspect (the eventuality is contained in the reference time) (Smith 1997: 110, Giorgi and Pianesi 1997: 163).

- Utterances are conceived of as instantaneous (Kamp and Reyle 1993: 536–537, Giorgi and Pianesi 1997: 160, Smith 1997: 110–112, 2003: 103–104, a.o.), a constraint we formulate concretely as follows:

(7) *Utterance Time Width (UTW)*
$|\text{TIME}(u)| < \varepsilon$, where ε is the minimum size for an event

With Utterance Time Width, TIME(u) — and hence $g(i)$ contained inside it — is too narrow to contain the event described by an activity or accomplishment. Only statives, which have the subinterval property (Dowty, 1979), describe an eventuality that is small enough. There is always some subpart of a state, satisfying the eventuality description, which can fit inside TIME(u).

(8)



Even achievements and semelfactives are incompatible with the canonical present, unless they have an habitual interpretation.

(9) a. # Bill **wins** the race.
Intended: 'Bill is winning/wins the race now.' *achievement*

b. # Sue **coughs**.
Intended: 'Sue is coughing/coughs (once) now.' *semelfactive*
(Smith, 1997: 111)

We take this to mean that the utterance time must, in fact, be so narrow that punctual events cannot be contained within it.

1.1. Extension to the play-by-play use

The play-by-play present, by our definition, is used in the direct reporting of circumstances as they unfold. It can be found in sportscasting (10a) and in demonstrations (10b) (Palmer 1965: 58, Leech 1971: 2–3).

(10) a. (USA vs. New Zealand, 2015 Women's Soccer Friendlies)
Commentator: Wambach **leads** it back and now Krieger **has** it. Tobin Heath **goes** far. (https://www.youtube.com/watch?v=Kqe9n7zvnnw, 1:40:55)

b. Demonstrator: Look, I **take** this card from the pack and **place** it under the handkerchief so. (Leech, 1971: 2)

Such play-by-play discourses do not require the perfective (a.k.a. simple present). There is a choice of aspect, depending on the nature of the events being described (Ferguson, 1983: 164). The perfective is used to describe a sequence of rapid, completed actions, as in a soccer game (10a), while the progressive is used to report longer, more continuous events, like those in a boat race (11).

(11) (Men's 8 Rowing Final, 2008 Olympics)
Commentator: Now the job for the Canadian crew is to hang on to the lead they had at the halfway mark. They **are breathing** hard. They really **are gulping** in the air there. But they know that they've got a good lead there. They know they can finish, but Great Britain **are moving** very well[. . .]
(http://www.youtube.com/watch?v=KkP3P5ucR4U, 5:37)

The play-by-play present always describes events that occur roughly at the time of utterance, so it exhibits Utterance Indexicality. Smith (1997: 111) offers one intuitive solution for why play-by-play sentences do not exhibit Stativity: they "telescope time. We understand them punctually, suspending our knowledge of their normal duration." In other words, durative predicates are coerced into describing an event small enough to fit inside the utterance time. Presumably, since the play-by-play present describes a completed interpretation in the perfective, this would include at least its end point.

(12)

There are several arguments that coercion cannot be what allows the play-by-play use to avoid Stativity. First, even punctual events are too large to be contained within the utterance time, as shown in (9) above, since achievements and semelfactives do not have a nonhabitual interpretation in the canonical present. The coercion operation that Smith implicates in the play-by-play present might, in principle, output an event small enough to fit within the utterance time. But this runs counter to conventional wisdom, which takes coercion to operate within a certain fixed inventory of eventuality predicates (Moens and Steedman, 1988; de Swart, 1998).

Second, if the play-by-play present involved coercion, then accomplishments should not exhibit the same ambiguity with *almost* that they do elsewhere (Dowty, 1979: 58).

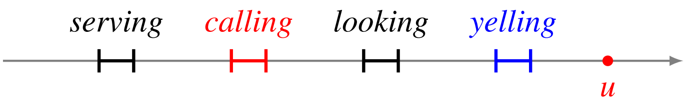
(13) John almost painted a picture.
'John didn't start painting a picture.'
'John started to paint a picture, but did not finish it.' (Dowty, 1979: 58)

But in fact, accomplishment predicates do exhibit this ambiguity in the play-by-play present.

(14) Commentator: Federer almost crosses the entire court.
‘Federer doesn’t start to cross the court.’
‘Federer starts to cross the court, but does not get to finish.’

Finally, coercion cannot offer an explanation for why a play-by-play sentence cannot anchor the past perfect. In (4a) above, by the time the past perfect sentence describing the calling event is uttered, the yelling event is already in the past and should be able to anchor it.

(15)



That is, to account for the play-by-play use, it is not enough simply to manipulate the event structure of the predicate. Something must be said about how the eventuality described relates to other times in the context.

1.2. Extension to the historical use

What we call the historical present is used to describe situations that have already taken place or are simply imagined. It makes them more “dramatic” as if “someone actually witness[es] the events as they are described” (Palmer 1965: 39, Leech 1971: 6–7, Close 1981: 106). This historical use is frequently found in ordinary narratives (16a) and stage directions (16b).

(16) a. I couldn’t believe it! Just as we arrived, up **comes** Ben and **slaps** me on the back as if we’re life-long friends. “Come on, old pal,” he **says**, “Let me buy you a drink!” I’m telling you, I nearly fainted on the spot.
(Quirk et al., 1985: 181)

b. From the right, Willy Loman, the Salesman, **enters**, carrying two large sample cases. The flute **plays on**. He **hears**, but is not aware of it. He is past sixty years of age, dressed quietly. Even as he **crosses** the stage to the doorway of the house, his exhuastion is apparent. He **unlocks** the door, **comes** into the kitchen, and thankfully **lets** his burden down. . .
(Miller, *Death of a Salesman*)

Assuming a typical utterance context, it is clear that a standard treatment of the present tense is incompatible with the historical use, since it does not exhibit Utterance Indexicality. However, the historical present could arise when the utterance context is *improper*, when one or more coordinates (e.g., speaker and addressee) does not coincide with the time coordinate (Predelli, 2005). For instance, in an answering machine message — *I am not here now, so please leave a message* — the time coordinate of the context might pick out the time of listening (decoding), even though the speaker does not utter (encode) the message at that time.

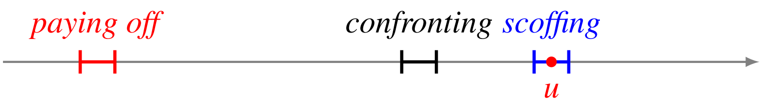
Eckardt (2015: 221–223) proposes that the historical present makes use of an improper context (see also Bary 2016). At the risk of oversimplying, we might represent this as an operator that shifts just the time coordinate of the context.

(17) $[\![\text{HP}(\phi)]\!]^{\langle \text{TIME}(u), \text{SPEAKER}(u), \ldots \rangle, g} = [\![\phi]\!]^{\langle t_i, \text{SPEAKER}(u), \ldots \rangle, g}$

In these discourses, then, the time coordinate of the context identifies a past time t_i. A standard semantics for present tense will consequently locate the reference time at this time, rather than the actual time of utterance. This correctly predicts that the speaker coordinate can pick out an individual who does not even exist at the shifted time, as in (18).

(18) Fifty eight years ago to this day, on January 22, 1944, just as the Americans **are** about to invade Europe, the Germans **attack** Vercors. **My grandfather** tries to escape. . . (Schlenker, 2004: 298)

Under this account, however, it is mysterious why the historical present *can* anchor the past perfect, as in (5a) above. The past perfect describes a paying-off event that precedes the time of the scoffing event. With a standard semantics for the past perfect (e.g., Reichenbach 1947), this time must itself be located anterior to the time of the context. But the time of the context still *overlaps* the time of the scoffing event when the past perfect sentence is uttered.

(19)


It is not enough simply to shift the time of the context to account for the historical present. Other tense-aspect categories, like the past perfect, are also sensitive to it.

1.3. The historical present in free indirect discourse

Before moving on, we should address a potential worry. One might think that the historical present is simply an instance of *free indirect discourse*, a literary style used to directly represent the perspective of a character (Banfield 1982; Doron 1991; a.o.). Indeed, many cases of the historical use feel as if they are filtered through the lens of a protagonist.

(20) a. **Creeping Christ?** he thinks. **What does he mean? His head turns sideways, his hair rests in his own vomit, the dog barks, Walter roars, and bells peal out across the water. He feels a sensation of movement, as if the filthy ground has become the Thames. It gives and sways beneath him; he lets out his breath, one great final gasp. You've done it this time, a voice tells Walter. But he closes his ears, or God closes them for him. He is pulled downstream, on a deep black tide.** (Mantel, *Wolf Hall*)

b. She rejected one brush; she chose another. **When would those children come? When would they all be off?** she fidgeted. **That man**, she thought, her anger rising in her, **never gave; that man took. She, on the other hand, would be forced to give.** (Woolf, *To the Lighthouse*)

It is not possible to reduce the historical present to free indirect discourse. The latter *necessarily* reports the perspective of a character (Banfield, 1982; Doron, 1991).

(21) Context: Figaro sees Coutess Almaviva, who is wearing his wife's clothes.
Figaro froze in place. He couldn't believe his eyes. **His wife** had swooned into the Count's arms and was now kissing him passionately. (Doron, 1991: 54)

By contrast, there are uses of the historical present that do not force reporting of a character's perspective (i.e., definite descriptions that are not valid with respect to the protagonist).

(22) Oedipus is very happy. He is going to see **his mother** again tomorrow.

While the historical present can occur in free indirect discourse, they cannot simply be equated. As it will turn out, we will adopt the semantics for the present tense that Sharvit (2004, 2008) proposes to account for free indirect discourse, and so we return briefly to this interaction later.

2. A proposal

We take natural language expressions to be interpreted relative to two contexts: a *context of utterance* (u) and a *context of assessment* (a). Such bicontextualism has been deployed in several empirical domains, including for free indirect discourse (Doron, 1991; Schlenker, 2004; Sharvit, 2004, 2008; Eckardt, 2015) and future tense (MacFarlane, 2003), as well as predicates of personal taste and epistemic modals (MacFarlane, 2014).

Individual expression can be sensitive to one, the other, or both of these contexts. Adopting the division that Sharvit (2004, 2008) proposes, local pronouns are sensitive to the utterance context, while tense is sensitive to the assessment context.

(23) a. $[\![\text{I}]\!]^{u,a,g} = \text{SPEAKER}(u)$
b. $[\![\text{you}]\!]^{u,a,g} = \text{ADDRESSEE}(u)$

(24) a. $[\![\text{PRES}_i]\!]^{u,a,g}$ is defined iff $g(i) \subseteq \text{TIME}(a)$. When defined, $[\![\text{PRES}_i]\!]^{u,a,g} = g(i)$
b. $[\![\text{PAST}_i]\!]^{u,a,g}$ is defined iff $g(i) < \text{TIME}(a)$. When defined, $[\![\text{PAST}_i]\!]^{u,a,g} = g(i)$

Sharvit takes temporal and locatival adverbials, such as *tonight* (25a) and *here* (25b), to be sensitive to the context of assessment.

(25) a. $[\![\text{tonight}]\!]^{u,a,g} =$ the night of the day surrounding $\text{TIME}(a)$
b. $[\![\text{here}]\!]^{u,a,g} = \text{LOCATION}(a)$

But we do not think that this is true of all temporal adverbials. In particular, those with *ago* seem sensitive to the context of utterance. The discourse below describes a series of past events. The continuation in (26a) is infelicitous because *two years ago* cannot receive a back-shifted interpretation: it picks out a time interval two years before the actual time of utterance.

(26) I couldn't believe it! Just as we arrived, up comes Ben and slaps me on the back as if we're life-long friends.
   a. # **Two years ago** he stole twenty dollars from me...
   b. **Two years before** he stole twenty dollars from me...

While Sharvit assumes that the two contexts are always identical in root contexts, we propose that the assessment context can be *freely chosen*, subject to pragmatic considerations. In this, we are adapting an idea of Schlenker (2004), who also makes use of two contexts in his account of the historical present. For him, there is a context of thought, where "a thought originates," and a context of utterance, where "a thought is expressed." In spite of a superficial similiarity, these do not line up with the two contexts we appeal to, as Schlenker divides up context-sensitive expressions differently. Simplifying somewhat, local pronouns and tenses are sensitive to the context of utterance, while temporal and locatival adverbials are sensitive to the context of thought.

In the historical present, Schlenker proposes that the context of thought is set to the actual context, while the context of utterance is located elsewhere (in the past, in the thinker's imagination, etc.) This leads to several complications. First, temporal adverbials — such as, *tonight* in (27) — can shift in historical present discourses, and hence must be fixed by his context of utterance.

(27) Forty years ago today John Lennon is about to take to the stage at the Cavern. **Tonight** his life will change forever. (Schlenker, 2004: 296)

Second, the context of utterance must be improper, since the speaker need not exist at the time of the events described in the historical present, as shown in (18) above. Consequently, Schlenker's account cannot explain its ability to anchor the past perfect (§1.2).

Most importantly, Schlenker does not offer a unified account of canonical and noncanonical uses of the present, which is our goal. While we adopt a different version of bicontextualism — in particular, a different division of context-sensitive expressions — we will crucially allow the context of assessment to diverge pragmatically from the context of utterance.

3. Deriving the noncanonical uses

In the canonical present, the assessment time does not diverge from the utterance time. Stativity and Utterance Indexicality thus arise for the same reasons that we described earlier.

(28) *Canonical present*
$\text{TIME}(a) = \text{TIME}(u)$

The noncanonical uses of the present tense arise when the assessment context stands in a different relation to the utterance context.

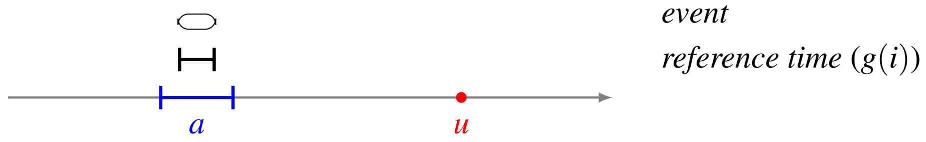
3.1. The historical present

Intuitively, the historical present can make something in the past "the present." For us, this involves pragmatically setting the time of assessment to some time before the utterance time. (For imagined events, the assessment time may not precede the utterance time, but it is similarly unmoored.)

(29) *Historical present*
$\textsc{time}(a) < \textsc{time}(u)$

Stativity for the canonical use arises from linking the assessment time to the utterance time, which must be very small. But if the assessment time is anterior, it can be wide enough for the reference time to contain a non-state.

(30)



The historical present thus does not exhibit Stativity.[3]

[3] Free indirect discourse can occur quite freely inside a narrative in the historical present.

(i) Louise places the parcel on the kitchen table. She can't wait to open it. **Who could have sent it? What does it contain? How shiny the wrapping paper is! The sender certainly must be rich. Today seems to be her lucky day.** (Eckardt, 2015: 221)

This is easy to derive under Sharvit's (2004, 2008) account of free indirect discourse (*pace* Eckardt 2015: 221–224 and Bary 2016). For the simplified version of this discourse in (ii), a FID operator in the present tense quantifies over contexts that are compatible with what Louise believes at the time of the *assessment* context, yielding the truth conditions in (iii).

(ii) Louise places the parcel on the kitchen table. **Today is her lucky day.**

(iii) When defined, $[\![$ FID-Louise-$\textsc{pres}_2$-w_0 Today $\textsc{pres}_3$ be her lucky day $]\!]^{u,a,g} = 1$ iff for every context-assignment pair $\langle a', g' \rangle$ such that a' is compatible with what Louise believes at $g(2)$ (where $g(2) \subseteq \textsc{time}(a)$) in $\textsc{world}(a)$, the day surrounding $\textsc{time}(a')$ is her lucky day at $g'(3)$ (where $g'(3) \subseteq \textsc{time}(a')$) in $\textsc{world}(a')$

Is it possible to shift into the historical present inside an FID context? This is not easy to show, but perhaps not.

(iv) Mary ran, stumbling, down the steps of the station. She was going to miss her train, she thought. How had she gotten here? She had been responsible and thought of everything.
a. # That morning, she **wakes** up bright and early, heading straight out the door. She **rushes** to the DMV and **gets** in line right when they open.
b. That morning, she **woke** up bright and early, heading straight out the door. She **rushed** to the DMV and **got** in line right when they opened.

Under Sharvit's account, a (non-double-access) present tense should *in principle* be possible when the FID operator is past, yielding a simultaneous reading like that available for a bound past tense. She argues that in such cases a preference for the bound past (based on a preference for *de se* pronouns) trumps the present tense (Sharvit, 2008: 388). The same should apply to the historical present as well.

It remains an open question how the assessment time is chosen in the historical present, if TIME(a) must simply precede TIME(u). We do not yet completely understand when or how this happens. On the one hand, speakers seem able to move the context of assessment at will, as shown by their ability to alternate freely between the past and the historical use of the present.

(31) Then all of a sudden everybody **gets** involved and they **made** a mess. So uh. . . this lady **says**. . . uh this uh Bert, "Oh, my son'll make them. He's an electrician." So he **makes** them, and he **charges** all the neighbors twenty dollars a set, and there I **paid** three dollars. So I **called** her a crook. And I **called** her son a crook. So, they **were** really mad at me. (Schiffrin, 1981: 46)

But on the other hand, there do seem to be constraints on what the context of assessment can be: it is hard to push it backwards.

(32) He looks at the ceiling.
  a. # Yesterday, a spider **is** climbing there.
  b. Yesterday, a spider **was** climbing there.

Perhaps, these two cases might be unified by a principle that only allows the assessment context to move forward in time. We leave this issue for the future.

3.2. The play-by-play present

Intuitively, the play-by-play use describes an event that ends "at" the utterance time. There is some evidence that speakers wait until an event has terminated to report it (Mathon and Boulaki, 2011). This can arise if the assessment time is pragmatically set so that it properly contains the utterance time.

(33) *Play-by-play present*
TIME$(a) \supsetneq$ TIME(u)

The play-by-play use does not exhibit Stativity, then, because TIME(a) can again be wide enough for the reference time to contain a non-state.

(34)


A caveat: The relation in (33) allows, in principle, for the assessment time to continue after the utterance time. This would permit an event to be *ongoing* during the utterance time. But this is not how people use the play-by-play present. As we showed in (10–11) above, there is a contrast between the simple present (for culminated events) and the present progressive (for ongoing ones). This suggests that there is an additional constraint at work: the Upper Limit Constraint (Abusch, 1997), which bans reference to times after the local "now." In our formulation, this amounts to a condition on the times of the two contexts:

(35) *Bicontextual Upper Limit Constraint (ULC)*
$max(\{t : t \in \textsc{time}(a)\}) = max(\{t : t \in \textsc{time}(u)\})$

If no part of the assessment time can follow the utterance time, then events will always have terminated by the utterance time in the play-by-play use of the present.

3.3. What other relations are possible?

One salient question is what other temporal relations between the utterance and assessment contexts are possible. There are eight relations one might imagine: $<, >, =, \subseteq, \subsetneq, \supseteq, \supsetneq, \circ$. However, as the following shows, our constraints on the width of the utterance interval and upper limits on $\textsc{time}(a)$ collapse several of these together.

(36) a. $\textsc{time}(a) < \textsc{time}(u)$: *historical present*
b. $\textsc{time}(a) > \textsc{time}(u)$: forbidden by the Bicontextual ULC (35)
c. $\textsc{time}(a) = \textsc{time}(u)$: *canonical present*
$\textsc{time}(a) \subsetneq \textsc{time}(u)$: difficult to distinguish from $\textsc{time}(a) = \textsc{time}(u)$, given UTW (7)
$\textsc{time}(a) \subseteq \textsc{time}(u)$: difficult to distinguish from $\textsc{time}(a) = \textsc{time}(u)$, given UTW (7)
d. $\textsc{time}(a) \supsetneq \textsc{time}(u)$: *play-by-play*
$\textsc{time}(a) \supseteq \textsc{time}(u)$: difficult to distinguish from $\textsc{time}(a) \supsetneq \textsc{time}(u)$
$\textsc{time}(a) \circ \textsc{time}(u)$: identical to $\textsc{time}(a) \supsetneq \textsc{time}(u)$, given the bicontextual ULC (35)

In the end, all possible relations between the utterance and assessment times reduce to just the three that are attested.

4. Accounting for the past perfect contrast

The ingredients are now in place to return to our initial empirical question: Why is the past perfect fine with the historical present, but not the play-by-play present?

(37) *Historical present*
Rumors of Berlusconi's crimes swirl. His advisors confront him. He scoffs.
a. He **had paid** off the prostitute for her silence already.
b. He **has paid** off the prostitute for her silence already.
c. He **paid** off the prostitute for her silence already.

(38) *Play-by-play present*
Commentator: Federer serves. It's long. He looks at the line. He yells in protest.
a. # The judge **had called** a fault.
b. The judge **has called** a fault.
c. The judge **called** a fault.

It should be noted that the play-by-play use is not alone. The past perfect is also incompatible with the canonical use of the present.

(39) *Canonical present*
Trump isn’t listening to his new campaign manager.
  a. # She **had let** him down.
  b. She **has let** him down.
  c. She **let** him down.

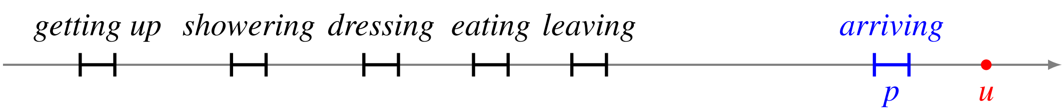
We suggest that this commonality is not accidental: both the canonical and play-by-play uses involve an assessment time that overlaps the utterance time. In the following we exploit this. We show how a perspectival treatment of the past perfect, like that of Kamp and Reyle (1993), can lead to temporal inconsistences in these uses, though not in the historical present, where the assessment time is unmoored from the utterance time.

4.1. Perspective in the past perfect

Kamp and Reyle (1993) propose that the past perfect can encode a Reichenbachian pluperfect, locating the reference time anterior to a salient past “perspective point.”[4]

(40) Fred arrived at 10. He **had got up** at 5; he **had taken** a long shower, **had got** dressed and **had eaten** a leisurely breakfast. He **had left** the house at 6:30.
(Kamp and Reyle, 1993: 594)

In narrative flashbacks, a sequence of past perfect sentences is interpreted as forward moving. Each sentence’s reference time advances, though they are all anterior to the same perspective point.

(41)


For Kamp and Reyle, past perfect morphology is compatible with a combination of two semantic features, which require the reference time to precede a perspective point that precedes the utterance time.

(42)
  a. +PAST: $p < \textsc{time}(u)$
  b. *past*: $g(i) < p$ (Kamp and Reyle, 1993: 601)

4.2. Incorporating the perspective point

We translate Kamp and Reyle’s framework into our own by equating p and $\textsc{time}(a)$:

[4] For Reichenbach (1947), the perspective point is the *reference time*. He does not aim to account for narrative flashbacks.

(43) *Past perfect in a bicontextual framework*
  a. $\textsc{time}(a) < \textsc{time}(u)$
  b. $g(i) < \textsc{time}(a)$

It is clear, then, why the past perfect is not compatible with the canonical and play-by-play presents. Its requirement that the assessment time precede the utterance time contradicts their pragmatic setting of the assessment time to (at least) contain the utterance time.

(44) *Canonical present*
$\textsc{time}(a) = \textsc{time}(u)$

(45) *Play-by-play present*
$\textsc{time}(a) \supsetneq \textsc{time}(u)$

Thus, only the historical present, which locates $\textsc{time}(a)$ before $\textsc{time}(u)$, allows the past perfect.

4.3. Equivalence with the simple past and present perfect

After a sentence in the historical present, the simple past and present perfect are able, intuitively, to describe the same event as the past perfect, as in (46), repeated from above.

(46) Rumors of Berlusconi's crimes swirl. His advisors confront him. He scoffs.
  a. He **had paid** off the prostitute for her silence already.
  b. He **has paid** off the prostitute for her silence already.
  c. He **paid** off the prostitute for her silence already.

The paying off event is anterior to the assessment time, satisfying the requirements of the past perfect. Those of the past tense are also met, which similarly requires that the reference time precede the assessment time.

(47) $[\![\textsc{past}_i]\!]^{u,a,g}$ is defined iff $g(i) < \textsc{time}(a)$. When defined, $[\![\textsc{past}_i]\!]^{u,a,g} = g(i)$

The present perfect, too, locates the paying off event before the assessment time. We assume that it encodes the combination of present tense and a (roughly Parsonian) perfect aspect, which describes the poststate of some eventuality.

(48) a. $[\![\textsc{pres}_i]\!]^{u,a,g}$ is defined iff $g(i) \subseteq \textsc{time}(a)$. When defined, $[\![\textsc{pres}_i]\!]^{u,a,g} = g(i)$
  b. $[\![\textsc{perf}\ \text{VP}]\!]^{u,a,g}(t) = 1$ iff $\exists e_1 \exists e_2([\![\text{VP}]\!]^{u,a,g}(e_1) = 1 \wedge \textsc{post-state}(e_2, e_1) \wedge t \subseteq \tau(e_2))$

The conditions in (48a–b) together ensure that there is a poststate of Berlusconi's paying off that overlaps the assessment time (e.g., the time of the scoffing in (46)).

The temporal differences between the past perfect, present perfect, and simple past are leveled, then, when the assessment time and utterance time are decoupled, as in discourses with the historical present.

5. Conclusion and future directions

We have combined three existing ideas in the literature: i) a bicontextual semantics for tense, proposed originally for free indirect discourse (Sharvit, 2004, 2008); ii) a bicontextual treatment of the past perfect, cf. Kamp and Reyle (1993); and, iii) pragmatic setting of the assessment context, cf. Schlenker (2004). Combining these approaches allows us to directly predict: the felicity of the present tense in its canonical, play-by-play, and historical uses; why the play-by-play and historical present do not exhibit Stativity, but the canonical present does; and, why the historical use is compatible with past perfect, but the other two uses are not.

Importantly, we do not have to appeal to any special mechanisms beyond the idea that pragmatics controls when the time of assessment diverges from the time of utterance. More generally, we have proposed that three diverse cases of temporal perspectival shift — free indirect discourse, past perfect anchoring, and the historical present — can be given a unified account as a shift in the same indexical coordinate, $\textsc{time}(a)$.

In closing, we would like to consider the prospects of extending this theory to other noncanonical uses of the present tense. In most cases, we believe, scrutiny will fall on our ancillary assumptions, not the bicontextual semantics itself. For performative uses, the question ultimately is how Stativity is obviated — is the assessment time unmoored, as in the play-by-play and historical present, or do such uses speak against the restriction on utterance width? For the futurate and future-like uses in (49a–b), the issues concern the ULC, which we appealed to for preventing the assessment time from following the utterance time.

(49) a. The Yankees **play** the Red Sox tomorrow. (Lakoff, 1971: 339)

b. Es bezieht sich. Wir **kriegen** Regen.
it cover.PRES.3SG self. we **get.PRES.1PL** rain
'It's getting cloudy. We'll get some rain.' (Hilpert, 2008: 170)

While the English case is a futurate (with a scheduled interpretation), the German just expresses probability. It thus may be that the present tense can impose different restrictions on $\textsc{time}(a)$ and $\textsc{time}(u)$ across languages.

In addition, a broader theory of the present tense should account for how its various uses are deployed in the construction of larger discourses. One concrete case is narrative progression, which the historical present licenses in the same way that the simple past does.

(50) a. John **gets up**, **goes** to the window, and **raises** the blind. It is light out. He **pulls** the blind down and **goes** back to bed.

b. John **got up**, **went** to the window, and **raised** the blind. It was light out. He **pulled** the blind down and **went** back to bed. (Partee, 1984: 253)

Early accounts of narrative progression linked it to specific properties of temporal and aspectual morphemes (Kamp and Rohrer, 1983; Partee, 1984; Hinrichs, 1986; Kamp and Reyle, 1993). The fact that the historical present also exhibits narrative progression suggests that it may, in fact, be more about the pragmatics of descriptions of event sequences (Kehler, 2002; Smith, 2003; Asher and Lascarides, 2003; Klein, 2009; Altshuler, 2010). What these pragmatic principles are, and how they should be integrated with tense, is a subject for future research.

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Kinds, epistemic indefinites, and *some*-exclamatives[1]

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Abstract. Although exclamative sentences have garnered much attention over the years, most work has focused on understanding what have been called wh-exclamatives and nominal exclamatives, to the exclusion of other types of exclamative constructions. I focus on what I call *some*-exclamatives, clausal exclamatives where the predicate uses the determiner *some*. I provide an analysis of these exclamatives, showing how their existence is motivated by independent properties of exclamative constructions and *some*.

Keywords: exclamatives, exclamation, genericity, kinds, indefinites

1. Introduction

In discussion of exclamatives in English, the vast majority of attention has been focused on analyzing and explaining the properties of *wh*-exclamatives (such as those in (1)), nominal exclamatives (as in (2)), and what Taniguchi (this volume) calls negative inversion exclamatives (like in (3)). These tend to form the canonical cases of exclamative sentences discussed in English.

(1) a. What a large watermelon!
 b. How beautiful the birds sing!

(2) The peppers he eats!

(3) Aren't you happy!

However, other exclamative and exclamative-like structures exist in English that have received much less attention compared to the aforementioned ones. One example of such an exclamative (and the topic of this paper) is a construction making use of a DP headed by the determiner *some*, what I call *some*-exclamatives. Although *some*-exclamatives have been discussed before (Israel, 1996, 2011), they remain relatively understudied compared to the better-understood *wh*-exclamatives and nominal exclamatives.

Some examples of these exclamatives are given in (4) through (7), with a paraphrase underneath each example. These exclamatives express a belief on the part of the speaker that the subject of the exclamative is of the type denoted by the noun phrase complement to *some* (such as *dancer* in (4)), but that their instantiation of this property is unexpected in some way.

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(4) Boy, was she (ever) some dancer!
"She was a dancer and she was an exceptional dancer."

(5) That was some wine she brought to the party!
"She brought wine to the party and it was very good wine."

(6) Some friend she turned out to be!
"She was a friend and she was a particularly poor friend."

(7) It's going to be some party!
"We're having a party and it's going to be a great party."

Israel suggests that the exclamative meaning in these is likely to be related to the hedging (epistemic indefinite) use of *some*. I will argue that the exclamative use arises from an interaction of two components. First, like Israel, I suppose that the epistemic indefinite use of *some* plays a role by creating a set of alternatives, and furthermore propose the existence of an exclamative operator that structures this set of alternatives and asserts an attitude towards a particular alternative from the set.

In looking at this particular type of exclamative structure, several questions arise. First, how does this type of exclamative structure relate to other types of exclamatives in English? Namely, what do *some*-exclamatives have in common with other exclamatives in English, such as *wh*-exclamatives, nominal exclamatives, and negative inversion exclamatives? To answer this question, it's necessary to ask a second question: what are the properties of *some* that allow for it to be involved in generating this exclamative meaning? This paper concentrates on this second question, in particular looking at the lexical semantics of *some* and how its indefinite meaning allows for an exclamative meaning to arise. Additionally, this paper looks at not only how the exclamative meaning arises, but also what is exclaimed about. I claim that *some*-exclamatives exclaim about a kind, in the sense of Carlson (1977).

This paper is structured as follows. Section 2 provides additional discussion of *some*-exclamatives; I distinguish *some* from the singular indefinite *a*, motivate *some*-exclamatives as exclamatives, and suggest that certain types of theories of exclamatives are not a very good fit for analyzing *some*-exclamatives. Then, in section 3, I argue that *some*-exclamatives are sensitive to kinds. In sections 4 and 5 I provide my analysis, with section 6 discussing additional data outside the purview of this paper. I wrap up my discussion in section 7.

2. Background

2.1. The data

Some-exclamatives come in two variants, what I call the in-situ variant and the preposed variation. In the in-situ variant, as in (8), the DP headed by *some* appears after the copula. In the preposed variant, illustrated with (9), the DP appears before the subject. In this paper, I focus on the in-situ variant, with the assumption that it's the underlying variant, while the preposed version is derived through movement of the *some*-headed DP.

(8) a. John is some lawyer! (in-situ)
 b. This is going to be some party! (in-situ)

(9) a. Some lawyer John is! (preposed)
 b. Some party this is going to be! (preposed)

Some generally doesn't give rise to exclamatives. One condition that must be met in order for the exclamative interpretation to be available is that there must be a particular intonational contour on the *some* indefinite. When this intonational contour is removed (marked with $_I$ in the examples below), the exclamative meaning is unavailable, and the ordinary indefinite meaning arises.

(10) a. That was some$_I$ wine she brought to the party!
 b. #That was some wine she brought to the party.

(11) a. It's going to be some$_I$ party!
 b. #It's going to be some party.

I propose that the intonation plays a role in creating the exclamative, in marking the presence of a morpheme carrying an exclamative operator. This operator, as I develop later, structures the set of alternatives denoted by the sentential core of the exclamative, and assert an attitude towards one of the alternatives.

Although *some*-exclamatives make use of *some*, which is used in constructing indefinite DPs in English, it is not simply being an indefinite that allows for *some* to have an exclamative use; English lacks a corresponding *a*-exclamative (as would be intended with the examples in (12)).

(12) a. #John is a lawyer!
 b. #It's going to be a party!

This lack of an *a*-exclamative suggests that there are additional properties of *some* that make it well-suited for being used in an exclamative. The next section briefly discusses how *some* and *a* differ.

2.2. *Some* is an epistemic indefinite

How does *some* differ from the singular indefinite *a*? The primary way that they differ is that *some* is an epistemic indefinite. Epistemic indefinites are indefinites that impose restrictions on the speaker regarding their knowledge of who the indefinite refers to. Unreduced *some* is the canonical case of this type of indefinite in English, although epistemic indefinites are well-attested cross-linguistically as well (Haspelmath, 1997).

In English, *some* contrasts with *a* in committing the speaker to uncertainty regarding the referent of the indefinite. The speaker may know some description of the individual, but the particular individual who satisfies the description cannot be known.[2] The short exchange in (13) illustrates this, where A's use of *some* commits A to not being able to identify the individual who was shot. B's question regarding the identity of the individual is odd because of speaker A's commitments due to using *some*.

(13) A: Some cabinet minister has been shot!
B: #Who?

In contrast, although *a* is compatible with a lack of knowledge, it doesn't require it in the way that *some* does. The exchange in (14) is acceptable, since although the use of the indefinite may signal that the speaker does not know who was shot, it doesn't commit the speaker to ignorance.

(14) A: A cabinet minister has been shot!
B: Who?

This contrast shows that there must be additional constraints on the use of *some* in order to capture a difference between *some* and the singular indefinite *a*. In my analysis, I will make a proposal for this difference that builds on work by Kratzer and Shimoyama (2002).

2.3. Is this really an exclamative?

Michaelis and Lambrecht (1996) note a collection of properties that exclamative constructions prototypically have. These are listed in (15). I argue that *some*-exclamatives should be considered as a type of exclamative based on the observation that *some*-exclamatives exhibit many of these properties.

(15) Semantico-pragmatic properties of exclamatives (Michaelis and Lambrecht, 1996)
a. presupposed open proposition
b. scalar extent
c. assertion of affective stance: expectation contravention
d. identifiability of described referent
e. deixis

First, *some*-exclamatives exhibit the (a) property in the above list. What Michaelis and Lambrecht mean by presupposed open proposition is that exclamatives are factive. *Some*-exclamatives are also factive, as can be shown by using the 'Hey, wait a minute!' test for presuppositions (Shanon, 1976; von Fintel, 2004).

[2]With some caveats, of course. *Some* can also express indifference with respect to the identity of the individual as well, which is plausibly related to its ignorance use. *Some* is also sensitive to different types of knowledge regarding an individual, such as naming them versus pointing them out in a crowd. See Maher 2013 for some discussion of this latter point.

(16) A: John is some lawyer! He always loses his cases!
B: Hey, wait a minute! I didn't know John was a lawyer.

As already noted, *some*-exclamatives seem to exclaim about some high scalar property as well, exhibiting the (b) property above. That exclamatives also express an attitude can be considered similar to the (c) property in the list. Finally, by deixis (property (e)) Michaelis and Lambrecht mean that the attitude in an exclamative is generally anchored both personally (with respect to an individual—the speaker) and temporally (to the speech time). This seems to hold in part for *some*-exclamatives as well, where the attitude is anchored to the speaker by default.

These properties also match in some ways with Zanuttini and Portner (2003)'s claim that exclamative constructions are factive, express a sense of noteworthiness, and cannot function in question/answer pairs. Given the similarities between *some*-exclamatives and other exclamatives in terms of their meanings, then, I will consider *some*-exclamatives to be a type of exclamative construction.

2.4. Theories of exclamatives

As exclamative constructions have been an important area for research for some time, there have been many different proposals for exclamatives in general as well as for constructions in particular languages. Although I cannot hope to do a thorough review of all of them, I'll note (following Castroviejo Miró (2008)) that the field has in some ways coalesced around three main types of theories regarding exclamatives: theories that assimilate root exclamatives to embedded exclamatives, theories that treat exclamatives as degree constructions, and theories that derive exclamatives from question semantics.

One style of theory of exclamatives attempts to understand exclamatives by assimilating root *wh*-exclamatives, such as those in (17), to embedded exclamatives like those in (18) (D'Avis, 2002; Abels, 2005).

(17) a. How tall John is! (root exclamative)
b. What a success the party was! (root exclamative)

(18) a. It's amazing how tall John is! (embedded exclamative)
b. I'm surprised what a success the party was! (embedded exclamative)

Embedded exclamatives clearly inherit much of their semantic force from the predicate they are embedded under (such as *amazing*). The hope for this style of theory is that root exclamatives can be represented by assuming that they too are embedded under an *amazing*-predicate, at some level of representation.

The difficulty with extending this approach to *some*-exclamatives is that *some*-exclamatives do not embed under *amazing*, *disappointing*, or other predicates we might have reasonably expected would be candidate predicates for this type of theory. This is shown in (19). It would seem then that, whatever the merits of this analysis, it is difficult to naively extend it to *some*-exclamatives.

(19) *It's amazing/disappointing/unexpected (that) John is some friend!

I turn now to a different type of analysis of exclamative constructions. In contrast with question theories of exclamatives, which treat exclamatives as being underlyingly questions, degree theories of exclamatives treat exclamative constructions as being on par with other degree constructions, such as measure phrase modification or comparatives. In other words, rather than accounting for the semantics of exclamatives by saying that they are sets of propositions, the semantics of exclamatives is accounted for by assuming that exclamatives make use of sets of degrees.

Some accounts in this type of theory are those of Castroviejo Miró (2006) and Rett (2008, 2011). Castroviejo Miró argues for a degree analysis of *wh*-exclamatives in Catalan based on the observation that the degree word *tan* in Catalan occurs in both exclamative environments and in canonical degree constructions. What makes exclamatives different from other sentence types is how they update the common ground. Assertions update the common ground to exclude worlds incompatible with the assertion, while exclamatives in this analysis background the information contributed by the degree construction, and implicate a speaker-oriented attitude towards a degree.

Rett (2011) also argues that exclamatives are degree constructions. She observes that exclamatives often make use of overt gradable expressions, such as in (20). When no gradable predicate is overt, however, a covert gradable predicate M-OP is used, where M-OP measures over a contextually salient dimension (in the cases in (21) below, the dimensions corresponding to *delicious* and *exotic* might be licit in context).

(20) a. What delicious desserts John baked!
b. The exotic places John visited!

(21) a. What M-OP desserts John baked!
b. The M-OP places John visited!

The core of the exclamative, for Rett, is a set of degrees (rather than a set of propositions). A process of default existential closure over degrees converts this into a proposition. A covert illocutionary operator expresses surprise towards that degree.

But, it's not obvious that this is the correct path to go down in order to analyze *some*-exclamatives as well. The reason for this is the nature of M-OP; M-OP is used to coerce gradability where none existed before, using some contextual salient scale. The difficult lies in the fact that *some* seems to already be involved with scalar meaning, namely quantity. For instance, the question-answer pair in (22) shows that *some* can be used to provide an answer expressing a quantity. Moreover, *some* is well-known to be part of a scale with the quantifier *all*.

(22) A: Was any of the wine spilled?
B: Some (of it).

Since *some* participates in a scale denoting quantity already, it seems reasonable to think that *some*-exclamatives should have an interpretation where they express surprise at a quantity. This type of reading is available with nominal exclamatives as in (23), showing that in principle an exclamative could have this type of reading. However, *some*-exclamatives do not seem to be compatible with a quantity reading, as (23) demonstrates.

(23) The wine we drank! It would've filled buckets!

(24) *That was some wine we drank! It would've filled buckets!

Finally, it's not clear that *some* is involved with degree constructions in general. For instance, generally expressions of the style in (25) aren't allowed in many varieties of English, including mine, further weakening a case for *some* having a degree component to it.

(25) a. *some tall!
b. *some sweet!

With these facts in mind, I set aside the possibility that *some*-exclamatives should be analyzed as degree constructions (but this of course doesn't rule out other exclamative constructions as being degree constructions).

Moving on, another sort of theory of exclamatives treats exclamatives as being semantically related to questions. Specifically, the propositional content of an exclamative is equivalent to that of a question, but the difference between a question and an exclamative lies in their sentential force. These kinds of theories adopt a semantics for questions in the style of Hamblin (1973), Karttunen (1977), and Groenendijk and Stokhof (1984).

Hamblin (1973) proposed that the denotations of questions were sets of propositions corresponding to answers to that question. A question of the form *Who came to the party?* could be considered as having the set of alternatives in (26), for instance, with *who* signaling the syntactic position where the alternative propositions should have their content varied. This set raises an issue as to which particular proposition is true.

(26) $$[\![\textit{Who came to the party?}]\!] = \left\{ \begin{array}{c} \text{Mary came to the party,} \\ \text{Bill came to the party,} \\ \text{Bob came to the party,} \\ \ldots \end{array} \right\}$$

This view of questions has come to be quite influential, and, with modifications later by Karttunen (1977) and Groenendijk and Stokhof (1984), the view that questions denote sets of propositions has become a dominant view in their analysis.

Under normal assumptions, declarative sentences denote propositions, functions from worlds to truth values, type $\langle s,t\rangle$. However, if this is so, what do sentences that aren't declarative denote? Hamblin proposes that questions are sets of propositions, a view further developed by Karttunen (1977) and Groenendijk and Stokhof (1984). The question *Who is coming?* might be represented as in (27).

(27) $[\![\textit{Who is coming?}]\!] = \lambda p \exists x\, [p(w) \wedge p = \lambda w' [\mathbf{come}(w')(x)]]$

Gutiérrez-Rexach (1996) adopts this view of questions and proposes that both questions and exclamatives have, at their core, essentially the same denotations. What sets exclamatives apart from questions is the use of an illocutionary operator *EXC* which operates on a variable indexed to the speaker, the world, and a set of propositions. Gutiérrez-Rexach's definition for this is as in (28), where *EMOT* is a set of emotive properties that speakers can have towards propositions, such as surprise and amazement.

(28) Let a be the speaker, w a world (typically the actual world), p a proposition, and $P \in EMOT$ (the set of emotive properties). Then,
$EXC \overset{\text{def}}{=} \lambda a \lambda w \lambda p_{\langle s,t\rangle} \exists P_{\langle s,\langle st,et\rangle\rangle}\, [P(w)(p)(a)]$

A somewhat different theory of exclamatives is that of Zanuttini and Portner (2003). In their analysis, Zanuttini and Portner follow Gutiérrez-Rexach in analyzing the core of a wh-exclamative sentence as being a question. Where Zanuttini and Portner's analysis differs is in the source of the exclamative reading itself. They argue that exclamatives have at their core a notion of domain widening.

The concept of domain widening here is related to the analysis of *any* in Kadmon and Landman (1993), where *any* is a simple indefinite determiner, but shifts the domain of quantification to a stronger domain when embedded under negation. In Zanuttini and Portner, domain widening applies at the level of propositions. Domain widening applies to the set of propositions denoted by the sentential core of the exclamative, and widens this set to include propositions not previously under consideration. Their definition of widening is provided in (29).

(29) Widening (Zanuttini and Portner, 2003)
For any clause S containing R_{widening}, widen the initial domain of quantification for R_{widening}, $D1$, to a new domain, $D2$, such that
i. $[\![S]\!]^{w,D2} - [\![S]\!]^{w,D1} \neq 0$ and
ii. $\forall x \forall y [(x \in D1 \,\&\, y \in (D2 - D1)) \rightarrow x < y]$

To illustrate how this works, let's consider the exclamative in (30). Zanuttini and Portner follow Karttunen (1977) in treating questions as denoting sets of true answers, so the set of alternatives for this exclamative is as in (31).

(30) What peppers he eats!

(31) $[\![$*What peppers he eats!*$]\!]$
$= \{p : p$ is true in w and $\exists a$ such that $p =$ [‘he eats a’]$\}$
$= \{$‘he eats poblanos’, ‘he eats serranos’, ‘he eats jalapeños’$\}$

To build the exclamative interpretation, the domain of this set of alternatives is expanded to include propositions that weren’t under consideration before. In the set in (32), which has undergone widening, the proposition *he eats habaneros* is now included. In essence, what the widening operation does is build the interpretation that this person eats a variety of peppers, and he even eats these extremely spicy peppers, habaneros. If there are any other peppers he eats, they’re not worth our consideration, since they’ve fallen outside of the widened domain.

(32) $\{$‘he eats poblanos’, ‘he eats serranos’, ‘he eats jalapeños’, **‘he eats habaneros’**$\}$

The difficulty in extending a question theory of exclamatives to *some*-exclamatives, however, is that *some*-exclamatives share little with questions in their surface structure. However, under some recent analyses (such as Kratzer and Shimoyama (2002)) indefinites do share semantic and pragmatic properties with questions, in that both interrogative sentences and declarative sentences with indefinites can be modeled as denoting sets of propositional alternatives. In the next sections, I develop a theory of *some*-exclamatives that builds on this kind of representation.

3. Kinds and *some*-exclamatives

I argue that, at their core, *some*-exclamatives are ultimately kind-related. That is to say, *some*-exclamatives make assertions involving kinds, as opposed to (say) degrees. There are two important pieces of evidence that kinds are involved in *some*-exclamatives. First, NPs that do not have clear, well-established kinds are odd in *some*-exclamatives. Going back to Carlson (1977), it’s been argued that reference to kinds depends on the accessibility of an established kind. Since green bottles (in (33a)) are not an established kind, they also do not allow for subkinds, and hence are illicit in *some*-exclamatives. A similar line of reasoning holds for (33b), as people that are in the next room do not form a kind.

(33) a. ??This is some green bottle!
b. #John is some person from the next room!

As noted by Constantinescu (2011), some nouns do not have readily accessible stereotypical properties associated with them, such as *building* or *room*. Since kinds correspond to general properties that characterize groups of individuals, we might suppose that the lack of stereotypical properties for *building* and *room* would make subkinds for them difficult to construe in many contexts. This predicts that *building* and *room* would be difficult to use in *some*-exclamatives, which seems to be the case (34). Other nouns that lack stereotypical properties, such as *non-Methodist*, are also difficult to use. The difficulty in using these nouns that do not denote kinds is another piece of evidence that *some*-exclamatives are kind-related.

(34) a. ??This is some building!
b. ??This is some room!

(35) ??He is some non-Methodist!

Finally, an additional piece of evidence suggesting that there is reference to kinds in *some*-exclamatives can be found by looking at post-nominal adjectives like *navigable* and *visible*. As noted by Bolinger (1967), these adjectives obligatorily get temporary, episodic interpretations when used post-nominally, as in (36). However, when these adjectives are used in the canonical pre-nominal position, like in (37), these adjectives either get the episodic interpretation, or an interpretation where they are commenting on inherent, stable properties.

Larson and Marušič (2004) go a step further and claim that this is a reflection of a stage-level/individual-level distinction, in the sense of Carlson (1977), where stage-level properties are temporary properties applying to spatio-temporally located stages of individuals, while individual-level properties are permanent properties applying to the whole individuals theirselves. This idea is closely related to kinds, in that instantiations of kinds (but not kinds themselves) are the sorts of objects that stage-level predications can be made of.

(36) a. the stars visible (stage-level only)
b. the rivers navigable (stage-level only)

(37) a. the visible stars (stage-level or individual-level)
b. the navigable rivers (stage-level or individual-level)

In *some*-exclamatives, pre-nominal adjectives are allowed, as shown in (38), while the same adjective is barred post-nominally. If Larson and Marušič (2004) are correct in identifying the post-nominal position as being related to stage-level interpretation, then this is further support for a kind-level interpretation being used in *some*-exclamatives. As episodic stage-level interpretations must be predicated of individuals, the fact that these post-nominal adjectives are allergic to the noun phrase in *some*-exclamatives suggests that the NP is also not a predicate of individuals.

(38) a. This is some navigable river! (We barely made it to the river mouth alive!)
b. These are some visible stars! (I can barely see them, and I know where to look!)

Finally, it should also be noted that Weir (2012) has proposed that, in certain cases, the determiner *some* (in its more familiar use) is sensitive to kinds. He notices examples such as (39), where what the speaker is expressing ignorance about is which kind of object is being referred to. These examples cannot be paraphrased with the form 'I saw a contraption in the copy room and I don't know which contraption it was,' but must be paraphrased with something more like 'I saw a contraption in the copy room and I don't know what kind of contraption it was.'

(39) a. I saw some contraption in the copy room this morning.
b. I came home to find some plant growing through a hole in my wall.
c. Doctor, some growth appeared on my arm. Should I be worried?

To conclude this, I will assume that kinds play a role in the interpretation of *some*-exclamatives. In particular, I'll suggest that *some*-exclamatives make reference to subkinds of the kind denoted by the NP that the determiner *some* combines with.

4. Kinds within the DP

In the previous section, I argue that *some*-exclamatives involve reference to kinds, at some level. The locus for reference to kinds in *some*-exclamatives, I'll assume, is within the DP. I mention a few proposals that form the background to my analysis in this section, where I will ultimately assume a model that is similar in spirit to that of Zamparelli (1995)'s idea of a layered DP.

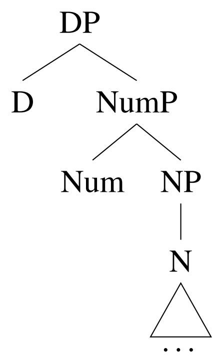
There are many proposals that put reference to kinds with the DP. One proposal is Zamparelli (1995). Zamparelli suggests that the DP be expanded into a number of functional projections (as in (40)). This creates a division of labor between the various projects in the structure; different types of semantic information are available at different levels in the DP structure, creating a close connection between the semantic derivation and the syntactic derivation.

Gehrke and McNally (2013) argue for a system similar to that of Zamparelli (1995), with kinds represented low within the DP. However, rather than treating the noun as directly denoting a kind, as Zamparelli does, they suggest that common nouns denote properties of kinds (see also McNally and Boleda 2004).

(40) $[\![car]\!] = \lambda x_k\,[\mathbf{car}(x)]$

In order to make this property something that can be predicated of ordinary objects, it must be transformed into a property of token entities and not kinds. They suggest, following related proposals by Déprez (2005) and Müller-Reichau (2011), that NumP is the locus for this operation. This is illustrated in (41), where *R* is a variant of Carlson (1977)'s realization relation, which relates kinds to individuals that instantiate them.

(41)



(42) $[\![[_{\text{NumP}}[_{\text{NP}}\ car]]]\!] = \lambda y \exists x_k\,[\mathbf{car}(x_k) \wedge R(y, x_k)]$

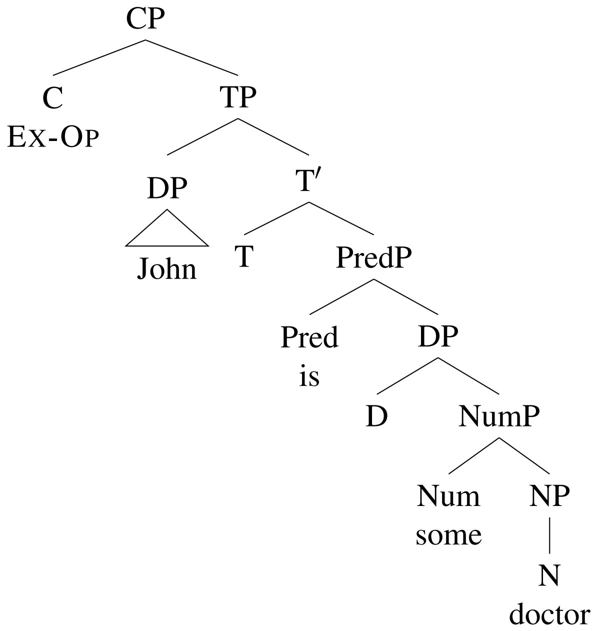
This has the benefit of providing a transparent mapping between syntax and semantics. I will assume a version of this in my analysis, where *some* plays the role of a Num head and realizes kinds.

5. Analysis

5.1. Structure of the exclamative

The basic core of a *some*-exclamative such as *John is some lawyer!* would be represented as in (43). I assume that these exclamatives are built essentially from a standard sentential core, with the crucial difference being the use of an exclamative operator EX-OP merged in C. The intonational contour of *some*-exclamatives is assumed to mark the presence of this otherwise covert operator.

(43)



5.2. The representation of *some* sentences

As discussed earlier, *some* is an epistemic indefinite, requiring that the speaker not have precise knowledge as to the identity of some individual. Although the particular way that this gets cashed out in different theoretical analyses varies, there are several that are especially worth attention here. The first that of Farkas (2002). Farkas analyzes *some* as requiring that the variable it contributes be unidentified—that is, that the value that variable is assigned not necessarily be the same across all possibilities. In essence, this is a way of ensuring that the speaker can never commit to a particular valuation for that variable.

A second is that of Alonso-Ovalle and Menéndez-Benito (2010). They propose that the ignorance implicature of Spanish *algún*, which is similar to *some* in some respects, can be modeled through competition with *un*. They analyze *algún* as in (44), where *algún* combines first with a subset selection function f, a function from sets to sets. The use of the subset selection function models contextual domain restriction. f in this analysis is restricted via the presupposition **anti-singleton**(f) so that its range must be a non-singleton set. When f combines with the restrictor of *algún*, the NP, the effect is to make it so that there must be at least two individuals that could possibly satisfy the existential claim. *Un* is analyzed as not having the anti-singleton presupposition, and the ignorance component of *algún* surfaces as an implicature through competition with *un*.

(44) $[\![algún]\!] = \lambda f \lambda P \lambda Q : \textbf{anti-singleton}(f).\exists x\,[f(P)(x) \wedge Q(x)]$

Finally, there is von Fintel (2000). This analysis is not about *some* per se, but about *whatever*, which also includes a sense of uncertainty about it.[3] Von Fintel builds on Dayal (1997)'s analysis of *whatever* in assuming that *whatever* includes a presupposition of ignorance. The presupposition is most relevant for my purposes here, in that it forces the speaker to not be able to identify which particular individual across worlds satisfies the predicate P, just that there are at least two.

(45) whatever$(w)(F)(P)(Q)$
a. Presupposes: $\exists w', w'' \in F : \iota x.P(w')(x) \neq \iota x.P(w'')(x)$
b. Asserts: $\forall w' \in F : Q(w')(\iota x.P(w')(x))$

What these proposals have in common is a general analytical intuition that epistemic indefinites and other morphemes that express ignorance impose a requirement that the speaker cannot commit to a particular individual. Rather, what these must do is leave as an open possibility that there are multiple individuals who could satisfy the descriptive claim that is being made. I borrow this intuition for my analysis of *some*.

For my purposes here, I adopt Kratzer and Shimoyama (2002)'s practice of analyzing all sentences—not only question sentences—as denoting sets of propositional alternatives. In particular, sentences making use of indefinites will have as their denotation a set of propositions that vary with respect to an individual (this will be developed in the next section). However, this formalization in and of itself does not build in a difference between the singular indefinite and *some*. To cash out the difference between the singular indefinite *a* and *some* in this sort of system, I give the principle in (46), the anti-singleton condition, which can be thought of as a use-condition associated with *some* but not *a*. What this principle serves to do is ensure that the speaker cannot narrow the set of alternatives to make an assertion about a single particular individual across worlds. This condition will be active in both normal sentences using *some*, and also exclamative sentences using *some*.

(46) Anti-singleton condition on *some*: A sentence containing *some* must denote a set containing at least two alternatives.

In the following sections, I show how the alternatives at the core of the exclamative vary with respect to a kind, and how an exclamative operator applies to this set.

[3] In class notes, von Fintel has an analysis of *some* that is similar, according to Alonso-Ovalle and Menéndez-Benito (2010). See von Fintel (1999).

5.3. The sentential core of *some*-exclamatives

Following the discussion the previously, I'll assume that NPs denote properties of kinds. The denotation for the NP *lawyer* will be the property corresponding to the lawyer-kind. This predicate will be true of any sub-kinds of the lawyer kind (or the kind LAWYER itself).

(47) $[\![lawyer]\!] = \lambda k.\mathbf{lawyer}(k)$

Based on proposals from Müller-Reichau (2011), Gehrke and McNally (2013) and others, Num will be the locus for shifting properties of kinds to properties of individuals. What shifts kinds to individuals in my analysis is *some*. Accordingly, *some* will be merged low, as a Num head, taking the NP as an argument, and yielding a property of individuals, as other indefinites do by assumption. The sentential core for a *some*-exclamative would be represented as in (48), where R is a realization relation. $R(x, y_k)$ is true just in case x is a realization of kind y_k.

(48) $[\![John\ is\ some\ lawyer]\!] = \{p' : \exists x_k \text{ s.t. } p' = [R(\mathbf{j}, x_k) \wedge \mathbf{lawyer}(x_k)]\}$

This representation of the sentence, though, still does not adequately model an exclamative meaning. In the next section, I propose an exclamative operator that is the final step in transforming the sentence into an exclamative.

5.4. The exclamative operator

A set of propositions isn't the right kind of semantic object to add to the discourse, as it is not a single truth value. In a non-exclamative sentence, a covert assertoric operator maps the set of alternatives corresponding to the sentence to a truth value (see Alonso-Ovalle and Menéndez-Benito 2010 and Kratzer and Shimoyama 2002 for discussion on what this kind of operator would look like). In the case of an exclamative sentence, a different operator applies. This operator, EX-OP, differs from an assertion operator in that it expresses a speaker-oriented attitude towards a proposition, rather than asserting a proposition itself. This attitude towards a proposition is what is added to the discourse. The special exclamative intonation that is attached to the *some*-exclamative marks the presence of this covert exclamative operator.

The exclamative operator EX-OP I define as in (49). This operator applies to a set of propositions P, asserts that there is an ordering to P (e.g., an ordering based on a property such as unexpectedness or surprisal), and then asserts an attitude towards the maximal proposition on this scale of propositions (MAX(P)). This attitude is indexed to the speaker.

(49) $[\![Ex\text{-}Op]\!] = \lambda P \begin{bmatrix} \text{there is a salient ordering for } P \text{ and} \\ \text{ATTITUDE}(\mathbf{speaker})(\text{MAX}(P)) \end{bmatrix}$

This building of a scale goes some way towards explaining why *some* and not *a* can be involved in generating an exclamative; as EX-OP imposes an ordering over the set of propositions, it will require a set for which there can be a non-trivial ordering. By entailing that there are at least two members, *some* will be suitable for this, while *a* will not be.

Applying EX-OP to the set of alternatives denoted by the sentence (e.g., a logical form such as in (48)) will yield a proposition such as in (50).

(50) $[\![Ex\text{-}Op(John\ is\ some\ lawyer)]\!]$
$=$ there is a salient ordering for $\{p' : \exists x_k \text{ s.t. } p' = [R(\mathbf{j}, x_k) \wedge \mathbf{lawyer}(x_k)]\}$ and $\text{ATTITUDE}(\mathbf{speaker})(\text{MAX}(\{p' : \exists x_k \text{ s.t. } p' = [R(\mathbf{j}, x_k) \wedge \mathbf{lawyer}(x_k)]\}))$

To summarize, *some* generates a set of alternatives that vary by subkinds instantiated by the subject. This set of alternatives is further constrained by a presupposition that says that this set must contain at least two alternatives in it. This constraint is what models the epistemic indefinite nature of *some* in other contexts. In the next section, I use this fact about *some* in conjunction with an exclamative operator to build the full meaning of *some*-exclamatives.

6. Addendum: Pejorativity and genericity in *some*-exclamatives

The majority of this paper has concentrated on what I've called the in-situ variant of the *some*-exclamative, where the DP containing *some* is in the position after the copula. In this section, I turn very briefly to the preposed variant.

The preposed variant is similar to the in-situ variant, in that both exclaim about some extreme property and the speaker asserts an attitude towards this. However, the preposed variant differs from the in-situ variant in that it requires a negative or pejorative evaluation on the part of the speaker; although the in-situ variant is compatible with this attitude, it does not require it. In other words, the preposed *some*-exclamative rules out any positive or neutral evaluation on the part of the speaker.

To illustrate this, consider the sentence in (51) with the (a) and (b) follow-ups. Both the (a) and (b) follow-ups are licit here, showing that the exclamative doesn't necessarily commit the speaker to either a positive or a negative evaluation of the subject; the speaker can use the exclamative to exclaim about John being both a good lawyer, and also a not very good lawyer.

(51) John is some lawyer!
  a. He always wins his cases and does lots of pro bono work.
  b. He loses every case and still charges a lot.

However, the preposed variant is different, as shown in (52), in that the (a) follow-up is incompatible with the exclamative while the (b) follow-up is still compatible. This shows that the exclamative in this case commits the speaker to a negative evaluation of John's abilities as a lawyer. This commitment to a negative evaluation rules out the follow-up in (a) that implicates a positive evaluation.

(52) Some lawyer John is!
  a. #He always wins his cases and does lots of pro bono work.
  b. He loses every case and still charges a lot.

One possibility is that the raising of the *some*-DP signals the presence of a syntactic projection encoding a pejorative attitude at the left edge of the clause. Similar proposals have been made for other phenomena, such as *shm*-reduplication in English (Grohmann and Nevins, 2004). But, a full analysis of the syntactic and semantic consequences of positing such a projection is beyond this paper.

Turning back to the role of genericity in *some*-exclamatives, one rub in the analysis in this paper is that perhaps *some*-exclamatives don't track the standard notion of kind very well, in that expressing surprise with respect to the subkind instantiated is marked. For instance, in (53), although knives with wooden handles and ceramic knives are subkinds of knives, the follow-ups in the (b) and (c) sentences suggest that the exclamative doesn't allow one to exclaim about these properties. Rather, the licitness of the (a) follow-up in (53) suggests that what the *some*-exclamative is exclaiming about is how the knife relates to the commonly associated event with knives, cutting. Similarly, the (b) follow-up in (54) is illicit, even though foot specialists are a kind of doctor. The (a) follow-up, which is licit, relates to the doctor's performance in doing his or her duties.

(53) Some knife this is!
  a. It couldn't even cut this banana!
  b. #It has a wooden handle!
  c. #It's made of ceramic!

(54) Some doctor he is!
  a. He couldn't diagnose my athlete's foot!
  b. #He's a foot specialist!

Although these examples do not (necessarily) weaken the claim I make that *some*-exclamatives involve kinds and genericity in some sense, it does raise questions about how to further define these notions with respect to *some*-exclamatives.

7. Conclusion

In this paper I've laid out an analysis of *some*-exclamatives, which have remained understudied in the broader literature on exclamatives. *Some*-exclamatives are interesting in that they show another example of an exclamative construction where the exclamative is not derived from morphology related to the formation of questions. The analysis I propose suggests a refinement of our understanding of exclamative sentences. Proposals such as those of Gutiérrez-Rexach (1996) and Zanuttini and Portner (2003) analyze exclamatives as having a question semantics. Recent work in the semantics of indefinites has argued that indefinites also have an alternative semantics associated with them, making them quite closely related semantically to questions. This connection allows us to very easily make sense of *some*-exclamatives and exclamatives as a whole; exclamative constructions are not about questionhood, as proposed by Gutiérrez-Rexach (1996) and Zanuttini and Portner (2003), but are rather about manipulating sets of alternatives.

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Games in linguistics[1]

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Abstract. In this paper we set out three consequences of a game-theoretic model for conversation, Message Exchange (ME) Games (Asher et al., 2016), which we think are of linguistic interest. We develop a notion of conversational success, explain subjectivity and bias in interpretation using concepts from epistemic game theory, and characterize the strategic usefulness of using so called expressions of "not at issue" content using ME games.

Keywords: epistemic games, conversation, discourse, conversational success, at-issue content, subjectivity

1. Introduction

The philosopher Grice long ago popularized the idea that conversation is a rational activity (Grice, 1975), yet curiously, efforts to apply philosophical and economic analyses of rationality and rational strategizing to linguistic phenomena have been sporadic and very restricted in their aims. Much of this work, including van Rooij (2004); Franke et al. (2012); Franke (2008) and Asher and Lascarides (2013), has been directed to the justification of Gricean maxims of conversation, often with the further aim of computing scalar implicatures. As argued in Asher and Lascarides (2013), the focus on Gricean maxims is largely misplaced: they are not in and of themselves an interesting *linguistic phenomenon*; they are an informal, and somewhat inchoate, description of what more formal models of rational interaction predict. Such formal models, when coupled with a well-developed theory of discourse structure and interpretation, have a much broader range of application to linguistic phenomena. In this paper, we argue that they play a crucial role in the analysis of three particular phenomena: evaluations of conversational success, not-at-issue/at-issue notions of content, and the subjectivity of interpretation. As we will make clear in our analysis of the subjectivity of interpretation, our formal model of rational strategizing affects how we structure and interpret a conversation. As some of us have argued at length that discourse structure affects many dynamic semantic phenomena (temporal structure, the interpretation of anaphora and ellipsis) as well as discourse content as a whole, these models thus have a general importance for understanding content in all its manifestations.

Mathematics, theoretical computer science and economics have produced a rich and pertinent body of work on which to draw in building a model of rational behavior. Conversations, for example, have a natural analysis as games. They typically involve at least two agents, each with their own interests and goals. These goals may be compatible or they may be in conflict, but in either case, one agent's successfully achieving her conversational goals will typically depend upon her taking her interlocutors' goals and interests into account. In cooperative conversations, in which agents' goals are completely aligned, conversational partners typically still need to coordinate actions, even linguistic actions. In strategic or non-cooperative conversations, in

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which participants have opposing interests concerning the outcome of the conversation, the necessity to consider the opponents' aims and actions is almost always even more important. A debate between two political candidates is an instance: each candidate has a certain number of points to convey to the audience, and each wants to promote her own position and damage her opponent's or opponents'. To achieve these goals, each participant typically needs to plan for anticipated responses from the other.

Our paper is organized into three main parts. First, we look at an application of a game theoretic model to the notion of conversational success and provide an abbreviated description of the technical details of the model, which we call *epistemic message exchange games*. We then show how the model sheds insight on the subjectivity of interpretation. In the third section, we apply the game theoretic model to an analysis of different types of content, in particular the distinction between what linguists call "at-issue" and "not-at-issue" content.

2. Conversational success

While linguists are accustomed to semantic evaluations in terms of truth and satisfaction alone, ordinary people evaluate their conversational contributions and those of others more generally in terms of what we call *success*. Did the agent achieve her conversational goals with her contributions or not? Conversational success thus has to do with the goals a conversationalist has. What, then, are conversational goals? One possibility is to identify a conversational goal extensionally as the set of conversations that are successful from the point of view of the speaker. Conversational goals are then defined as subsets of the set of all possible conversations that exclude those conversations that do not go well. Sometimes a conversation will count as successful in virtue of containing a particular verbal string, as illustrated in (1).

(1) a. EPA administrator : May I look inside the containment structure?
b. Ghostbuster (Bill Murray): You didn't say the magic word.
c. EPA administrator: Please, may I look inside the containment structure?
d. Ghostbuster (Murray): No. (from *Ghostbusters*)

At least one of the goals of Murray's character is simply to have the EPA administrator prefix his request with the word *please*. If we define this goal extensionally, we end up with the set of all conversations in which that string follows (1a) and (1b). Most conversational goals, however, are not defined by particular strings. What matters are the commitments to conversational contents that the interlocutors ultimately adopt. An evaluation of conversational success therefore typically has ties to a conversation's content or its ordinary semantic evaluation. Importantly, this does not mean that the content of a conversation must be *true* or accurate; a conversational contribution may be successful in persuading an interlocutor to do something, for example, even if the contribution is inaccurate or false. Certain 2016 US Presidential campaigns provide ample evidence of this possibility.

Content related goals can be tied to particular discourse moves. Following Asher and Lascarides (2003), asking a non-rhetorical question, for instance, indicates that the speaker has the conversational goal of obtaining an answer from her interlocutor or interlocutors. A simple conversational goal for an assertion is typically to have one's interlocutors agree or at least not openly object to it. Asher and Lascarides (2003) call such goals *speech act related goals*.

Conversational goals, however, can also global, general properties of a conversation that guide a large stretch of discourse or even the conversation as a whole. Consider, for instance, a prosecutor who either wants a witness to commit to some issue or wants to demonstrate before a jury that the interlocutor is evading or refuses to answer the question. Success may require several discourse moves (and may never be achieved at all). As a real life example, consider the following exchange between CNN's Jake Tapper and Mike Pence, who was the US Vice-President elect at the time.[2] Tapper asks Pence if he was aware that the transition team for Trump's presidency had put in for a security clearance for Michael Flynn Jr., the highly controversial son of Trump's choice for National Security Advisor. Pence repeatedly dodges the direct yes or no question, forcing Tapper to point out why all of Pence's attempts to deflect the question were not answers. While Tapper never succeeds in getting a direct answer from Pence, his eventual success in extracting at least a strong implicature that Pence was aware of the demand for clearance required a series of arguments pointing out why each attempt at diversion by Pence was just that.

More often than not, the goal of a particular conversation such as an interview or a debate will be a combination of simpler conversational goals in some temporal logic like Linear Temporal Logic (LTL) (Lamport, 1980), which includes the temporal operators $\Diamond$ for *eventually* and $\Box$ for *always*, as well as operators for the temporal relations *since* and *until*. A reporter, for example, might have the complex goal of eventually getting a satisfactory answer to each of her individual questions to her interlocutor, and the goal of getting an answer to a question Q, as we have seen, typically has the general form: until an answer to Q is produced, show that no answer to Q has been given and then repeat Q. A more complex goal, which might be adopted by a participant in a political debate, is to reply to every attack on her and to land more attacks on her opponent than he lands on her. This goal is not expressible in LTL, but is in the framework we develop below.[3] Asher et al. (2016) provide many examples of such goals and show how these goals may differ in complexity. They also show how to link goals to strategies for achieving them.

Games provide natural structures within which to investigate the success of sequences of linguistic actions. Game theory evaluates actions in terms of utility, and the simple Boolean case of winning conditions we have alluded to above is an instance of a utility function. Signalling games (Lewis, 1969; Spence, 1973), which have been very popular in linguistics, are not appropriate for the task, however. Signalling games are designed to tackle a different aspect of language, namely, the coordination on linguistic content in reflective equilibrium (see Lewis's account of the emergence of linguistic conventions). By contrast, we are interested in evaluations of conversational success, even—and especially—in cases where interests of the conversationalists are opposed. In such cases the meanings of messages in the context of sig-

[2] 'Pence pressed on clearance for Flynn's son,' *The Lead*. The full exchange can be viewed here: http://edition.cnn.com/videos/politics/2016/12/06/mike-pence-trump-flynn-jr-transition-lead-bts.cnn

[3] See Asher et al. (2016) for details.

nalling games is problematic to say the least; Crawford and Sobel (1982) show that in cases of opposing interests messages cease to have content in reflective equilibrium.

Our game theoretic model is different from signalling games in several respects. For one, we will take messages to have an exogenously given meaning that determines how one conversationalist responds to the messages of another. This allows us to avoid the problems of message interpretation in signaling games where the interests of the players are opposed. Another way in which our model differs from signaling games is that while signaling games are typically "one shot", a good model of conversational goals, as suggested in the examples above and argued in detail in Asher et al. (2016), should require agents to strategize about conversations as open-ended sequences of moves with no set end. In the exchange between Jake Tapper and Mike Pence, described above, Tapper had the goal of eventually getting an answer to his question about Michael Flynn Jr., and he didn't stop his line of questioning until he got at least an implied answer; he had to be prepared for an open-ended set of moves by Pence designed to avoid the question. In general, conversational agents must plan for any number of moves by their opponents to try to frustrate or to prevent them from achieving their goals. In fact, we can put no *a priori* upper bound on the number of moves that accomplishing this goal might require, and thus a game theoretic framework for conversation must countenance a potentially infinite sequence of exchanges of messages between conversational participants.

To model these aspects of strategic conversations, Asher et al. (2016) developed a game theoretic framework of *Message Exchange* or ME games. The intuitive idea behind an ME game is that a conversation is a sequence, either finite or infinite, of turns. In each turn, one of the players 'speaks' or plays a sequence of moves, and each sequence of moves itself describes a discourse structure in the sense of SDRT (*Segmented Discourse Representation Theory*; Asher and Lascarides, 2003) that extends the discourse structure built up from previous turns. More precisely, the vocabulary V of an ME game contains a set of discourse unit labels $\mathsf{DU} = \{\pi, \pi_0, \pi_1, \ldots\}$, a set of formulas from a language for dynamic semantics that serve to describe the contents of the basic units (where '$\pi\colon \phi$' means that the formula ϕ describes the contents of the discourse unit π), and a set of discourse relation symbols $\mathscr{R}$ relating discourse constituents from the different moves made so far in the game.

Turns in ME games are relativized to players. In the case of conversations, it is essential to keep track of "who says what"; Tapper saying that Pence had knowledge of Flynn Jr.'s past is not the same as Pence himself admitting to having had this knowledge. To model this, each player i is assigned a copy V_i of the vocabulary V of SDRT moves, which is simply given as $V_i = V \times \{i\}$. Thus when Player i plays $u \in V$, it is noted as (u,i). Conversations correspond to plays of ME games which are finite or infinite sequences over $(V_0 \cup V_1)$, noted as $(V_0 \cup V_1)^\infty$, for a game with two players, 0 and 1 (for details see Asher et al., 2016; Asher and Paul, 2017).

Given that we have defined a conversation as a sequence or element of $(V_0 \cup V_1)^\infty$, a conversational goal will be a subset of $(V_0 \cup V_1)^\infty$. But who determines what the goals are in a given conversation? That is, who determines which subsets of $(V_0 \cup V_1)^\infty$ represent success? Speakers presumably have their internal goals, but it is not necessarily those that determine conversational success. Each person who is involved in or who witnesses a conversation has her own ideas about what the winning conditions of the participants are or should be.

To this end, Asher et al. (2016) introduced a crucial component for analyzing conversations that they called the *Jury*. The Jury determines the conversational goals of the participants. The Jury is itself an abstract decision rule determining winning conditions, but it can be instantiated with the conversationalists themselves, or with a third party that evaluates the conversation. In strategic settings, taking conversational partners as evaluators can lead to trouble, as each will be tempted to declare him- or herself the winner. In many settings such as political debates, the natural Jury to consider is the actual audience, some segment of the population who witnessed the debate or the whole set of participants, or yet some other body like the editorial board of a newspaper.

Asher et al. (2016) consider only an impartial Jury, who also enforces constraints like the consistency of a player's contributions or the constraint that a player respond to questions or other moves of the other players. For most conversations, however, there will be many Juries. These Juries may disagree with each other about winning conditions, and some may have a very biased take on a conversation. Nevertheless, given what we have said so far, we will need to evaluate conversational success relative to a particular Jury. Accordingly, ME games pair the space of possible conversations $(V_0 \cup V_1)^\infty$ with a Jury $\mathscr{J}$.

Evaluating conversational success is to a certain extent a subjective or relative matter, since it depends on the conversational goals assigned to players by the Jury. Different juries may disagree as to what the conversational goals should be, and a group of people or even a single person may be undecided as to what sort of Jury she is. Still, once a goal is set as a subset of $(V_0 \cup V_1)^\infty$, it is an objective matter as to whether the conversation meets this goal or does not; either the conversational play is an element of the subset designating a conversationalist's winning condition or it is not.

A final point concerns the evaluation of conversational success. When does a Jury decide a conversationalist has met the winning condition assigned to her? While for Asher et al. (2016) a Jury must survey an entire conversational string and all its continuations, which may be infinite, Asher and Paul (2016) argue that this misses the fact that an actual Jury evaluates in a dynamic fashion, after each turn by one of the conversational participants. The idea is to represent a winning condition by a scoring function over players' conversational turns. A turn can be rated more or less good with respect to the winning conditions the Jury has in mind, or more or less disastrous. If the Jury has a scoring function with a discounting parameter that lowers the score for turns later in the conversation, it will always being able to confidently pick a winner in a 0 sum game within a finite amount of time. Asher and Paul (2016) illustrate how such a scoring function works on a snippet from one of the debates between candidates for the Republican Presidential candidate of 2016.

So what is the import of ME games for linguistics? The field of pragmatics has always been concerned with the use of language, and ME games yield a formal pragmatic framework that provides principled reasons for why and how we use language to attain conversational goals.

Hearkening back to the concerns of traditional rhetoricians, our account answers the question: what is a reasonable scoring function and how should a conversationalist attempt to maximize her score? To answer this question, the framework of ME games replaces semantic evaluation in terms of truth at a world with pragmatic evaluation in terms of conversational success relative to a Jury. The underlying structure of game theory also generates a notion of logical consequence for conversational success, a very rough approximation of which would be LTL's notion of consequence, which works for simple goals, though the nature of the full consequence relation is as far we know unexplored. Finally, the framework predicts whether there is a winning conversational strategy for a given goal and what it would look like in linguistic terms.

3. The subjectivity of interpretation

In this section, we explore the nature of a Jury's scoring functions, and in particular how subjectivity and bias naturally influence them. One of the astounding facts about conversations is that people who participate in or merely observe them can come away with dramatically different interpretations of what was said, even though not everything goes. Different Juries can disagree about what was said, what was implied, and about who was successful. Consider, for instance, the one-line retort by Presidential candidate Trump to Presidential candidate Clinton during the third US Presidential debate in 2016:

(2) Such a nasty woman.

The literal meaning and the conventional implicatures of this remark in context are clear; with (2), Trump committed himself to a negative assessment of Clinton. However, people perceived the role of (2) in achieving an agent's conversational goals very differently. One Jury, an appreciable segment of the American population, found this remark totally out of place in a Presidential debate. Another one, Trump's base, found the comment appropriate and would have assigned it a high score. Each of these interpretations depends on how the Jury assigns winning conditions to the players, which includes constraints under which, the Jury judges, conversations should be conducted.

Bias and subjective beliefs will also influence the way that a Jury interprets the very structure of a discourse. Consider the following excerpt, discussed at length in Asher et al. (2016), from a press conference by Senator Coleman's spokesman Sheehan. Senator Coleman was running for re-election as a US senator from Minnesota in the 2008 election.

(3)
a. **Reporter:** On a different subject is there a reason that the Senator won't say whether or not someone else bought some suits for him?
b. **Sheehan:** Rachel, the Senator has reported every gift he has ever received.
c. **Reporter:** That wasn't my question, Cullen.
d. **Sheehan:** (i) The Senator has reported every gift he has ever received. (ii) We are not going to respond to unnamed sources on a blog.
e. **Reporter:** (i) So Senator Coleman's friend has not bought these suits for him? (ii) Is that correct?
f. **Sheehan:** The Senator has reported every gift he has ever received.

Sheehan continues to repeat, *The Senator has reported every gift he has ever received* seven more times in two minutes to every follow up question by the reporter corps.[4]

While many of the contributions by Sheehan and the reporter corps have a clear and uncontroversial meaning and discourse function, some contributions are open to interpretation. For instance, how are we to interpret the response α by Sheehan in (3b), (3d.i), and (3f)? ME games provide an insightful answer. To formulate the above exchange as an ME game, we first fix the players and the Jury. We can assume that there are two active players: the reporter corps (R) and spokesman Sheehan (S). We will also consider two Juries, each of which interprets the exchange differently. The first, Jury 1, starts out with a presumption of full disclosure and honesty from S; Jury 2 is a biased Jury that is disposed to believe whatever the spokesman says, because, for example, Jury 2 and S are from the same political party. We'll see below that Juries 1 and 2 will arrive at different interpretations of the structure and content of (3), and in particular, of S's repeated response.

To model the subjectivity of conversational interpretation, we must clarify what elements of a discourse structure are influenced by subjective interpretation. Asher et al. (2016) and Asher and Paul (2016) assume no ambiguity in the discourse moves made by players in an ME game (though for a look at a prior treatment of ambiguity in the ME setting, see Venant and Asher, 2015). However, at least at a first pass and assuming a perfect communication channel, it is the ambiguous moves that are up for interpretation, so we will need to countenance some ambiguity. At the same time, not everything is up for interpretation—an emphatic *no* to a polar question doesn't mean *yes*.

We will assume that the grammar, including syntax and lexical and compositional semantics, delivers an unambiguous core or, following Asher and Lascarides (2003), an *underspecified logical form* (ULF) for a discourse. We will also distinguish between *plays*, the objective components of discourse moves that are uncontroversially part of the speakers' public commitments, and *histories*. A play in our ME games is a ULF, and given our assumption about exogenously given meaning, we will assume this ULF and its interpretation are common knowledge of the players and the Jury. Of course, a ULF typically involves underspecified elements (whose semantics we can specify via existential quantifications over variables standing for the elements that require specification) that are specified via reasoning that depends on a variety of subjective sources. For (3), the observed play, call it play ρ, is a representation for (a-f), in which each contribution has its normal compositional semantics and some of the uncontroversial discourse connections, like the fact that (c) corrects the discourse connection between (a) and (b), are made explicit. Other relations are left underspecified, including the relation between (a) and (b), (c) and (d.i), and (e) and (f).

(4) provides the ULF for (3), where each π_n labels an SDRT formula, $Sel_{\mathbb{R}}$ is a selection function over discourse relations that signals the presence of underspecified relations, and Sel_{Π} is a selection function over discourse units that marks the presence of underspecified arguments.

[4]See `http://www.youtube.com/watch?v=VySnpLoaUrI`.

(4) $\pi_2 : (\pi_0 : 3a \wedge \pi_1 : 3b \wedge Sel_{\mathbb{R}}(\pi_0, \pi_1)) \wedge \pi_3 : 3c \wedge Correction(\pi_2, \pi_3) \wedge$
$\pi_7 : (\pi_6 : (\pi_4 : 3d.i \wedge \pi_5 : 3d.ii \wedge Explanation(\pi_4, \pi_5)) \wedge Sel_{\mathbb{R}}(Sel_{\Pi}, \pi_6)) \wedge$
$\pi_{10} : (\pi_8 : 3e.i \wedge \pi_9 : 3e.ii \wedge Confirm\text{-}Question(\pi_8, \pi_9)) \wedge Result(Sel_{\Pi}, \pi_{10}) \wedge$
$\pi_{11} : 3f \wedge Sel_{\mathbb{R}}(Sel_{\Pi}, \pi_{11})$

Here is a gloss of the ULF (4). π_1 is a *complex* discourse unit (CDU) that groups together π_0 and π_1, which are related via some underspecified relation, $\mathscr{R}_1$, which is the target of the correction in π_3. In SDRT, when a correction targets a relation instance, the Correction must take scope over a CDU containing that relation instance. It is also uncontroversial that Explanation holds between π_4 and π_5 and that a Confirmation-Question relation holds between π_8 and π_9. On the other hand it is unclear how to connect the CDU π_6 or the unit π_{11} to the preceding context.[5] The explicit discourse connector *So* signals a result between π_6, π_{10} or some other discourse unit and the CDU π_{10}. However, the left argument of this relation and those of the two underspecified relations are themselves underspecified which we note using the function Sel_{Π}.

But (4) only represents one possible play in an ME game tree. There could be many more branches. Figure 1 below depicts how (4) and alternative plays branching out from it would form an ME game tree. The relation instances with underspecified arguments are drawn in red.

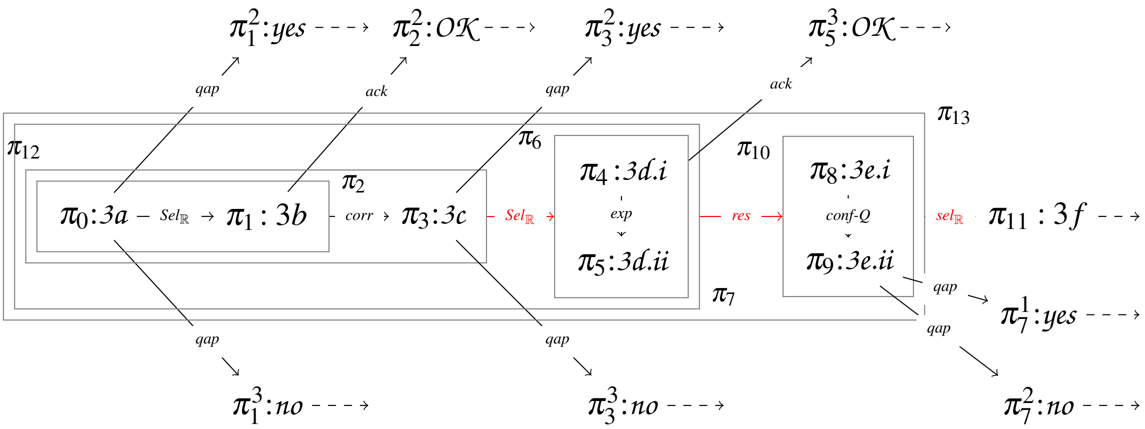

Figure 1: A game tree of plays for (3)

A *history* is a completed SDRS that fills in the underspecified elements of a ULF and thereby serves as an interpretation of a given play. (5) and (6) fill out two histories, h_1 and h_2, for the observed play ρ and ULF of (4). IQAP stands for Indirect Question-Answer-Pair.

(5) $\pi_{12} : (\pi_2 : (\pi_0 : 3a \wedge \pi_1 : 3b \wedge Background(\pi_0, \pi_1)) \wedge \pi_3 : 3c \wedge Correction(\pi_2, \pi_3)) \wedge$
$\pi_{13} : (\pi_7 : (\pi_6 : (\pi_4 : 3d.i \wedge \pi_5 : 3d.ii \wedge Explanation(\pi_4, \pi_5)) \wedge Correction(\pi_{12}, \pi_6)) \wedge$
$\pi_{10} : (\pi_8 : 3e.i \wedge \pi_9 : 3e.ii \wedge Conf\text{-}Q(\pi_8, \pi_9)) \wedge Res(\pi_7, \pi_{10})) \wedge \pi_{11} : 3f \wedge Backgr(\pi_{13}, \pi_{11})$

[5] In fact, it is unclear whether the CDU π_6 even exists or whether π_4 alone will relate to the preceding context. We have assumed a CDU for simplicity.

(6) $\pi_{12}: (\pi_2: (\pi_0: 3a \wedge \pi_1: 3b \wedge IQAP(\pi_0, \pi_1)) \wedge \pi_3: 3c \wedge Correction(\pi_2, \pi_3)) \wedge$
$\pi_{13}: (\pi_7: (\pi_6: (\pi_4: 3d.i \wedge \pi_5: 3d.ii \wedge Explanation(\pi_4, \pi_5)) \wedge Correction(\pi_{12}, \pi_6)) \wedge$
$\pi_{10}: (\pi_8: 3e.i \wedge \pi_9: 3e.ii \wedge Conf\text{-}Q(\pi_8, \pi_9)) \wedge Res(\pi_7, \pi_{10})) \wedge \pi_{11}: 3f \wedge Correct(\pi_{13}, \pi_{11})$

To analyze how histories develop from plays, we use the tools of epistemic game theory. We present a detailed, formal development in Asher and Paul (2017), but sketch the essentials and the linguistic consequences here. In moving from ME games to *epistemic* ME games, we exploit the notion of a *type*, a fundamental tool in epistemic game theory that Harsanyi (1967) used to represent information that players have about each other. In particular, we add to an ME game $\mathscr{G} = ((V_0 \cup V_1)^\infty, \mathscr{J})$, a set of types for the players 0 and 1 and for the Jury $\mathscr{J}$. To model the beliefs of an individual i, which may be a player or the Jury, we also add a function β from a pair of a play ρ, where $\rho \in (V_0 \cup V_1)^\infty$, and type t for i to a probability distribution over types for the other players, types for the Jury, and possible histories (complete SDRSs) given ρ. As the conversation evolves, players will update their beliefs about the history of the conversation and the type of the other players using Bayesian conditionalization over new conversational events they observe (Stalnaker, 2009).

Returning to Example (3), there are two types relevant for interpreting S: the *dishonest* type, t_D, according to which S is trying to cover up the fact that Coleman received the suits but did not declare them, and the *honest* type, t_H, according to which S truly implicates that the Senator did not receive the suits and simply does not want to respond to this charge based on an uncertain source (see (d.ii)). To illustrate how types affect interpretation, we will take the Jury to assign victory conditions in terms of two types: R wins if S's conversational contributions confirm he is of type t_D; S wins if his contributions confirm he is of type t_H. The Jury updates its beliefs about the types of the players as the players make new moves. We now break down the two cases, t_D and t_H, in more detail.

Case 1: Before the start of the press-conference, in the absence of other information, Jury 1's type t is indifferent with respect to S's honesty. That is, the Jury starts with a prior assigning equal probability to t_H and t_D.

Let α be the ULF for (3b). When the Jury updates with the unexpected α as a response to (3a), they are genuinely puzzled by the response. While it's natural to assume that an honest senator has reported every gift he has received, the inference from α to an answer to (3a) (why won't the Senator say who bought the suits?) is complicated and indirect. A Jury must consider the interpretation of (3a) and (3b) conditional on both t_D and t_H. Conditionalizing on α and the assumption that S is of type t_D, the Jury, like R, assigns a high probability to the interpretation illustrated in $\hbar_1$, that (3b) does not answer (3a) and is rather related to it via Background. Conditionalizing on α and the assumption t_H confers only a slightly higher probability to an IQAP relation than a Background relation between (3a) and (3b). When we combine the probabilities over t_D and t_H—because Jury 1 is considering both—we therefore get a higher probability for ¬IQAP than for IQAP, leading to higher probability of $\hbar_1$. Conditionalizing in turn on these relative values, the Jury naturally interprets R's response in (3c) as a Correction of S's move in (3b) under the interpretation of (3b) as implicating an answer and therefore satisfying R's request for a direct answer in (3a). In (3d.i), however, S corrects R's Correction, reiterating his original response, and explains why he does so in (3d.ii): the Senator and his staff do not want to comment on unnamed sources on some blog. This would seem to follow whether we conditionalize on t_H *or* t_D.

The upshot of Sheehan's correction should be that (3b) *is* in fact related to (3a) via IQAP. R then picks up on this conclusion and asks a Confirmation Question to confirm that this is indeed the case. We show this by linking (3e) to the graph built up from (3a)-(3d) with Result in both h_1 and h_2. At this point we could imagine that for our Jury $\mathscr{J}$, $\text{prob}_{\mathscr{J}}(t_H)$ is once again equal to $\text{prob}_{\mathscr{J}}(t_D)$ and h_1 and h_2 are equally likely. But now things go downhill for Sheehan in the eyes of Jury 1. Sheehan in effect refuses to engage with R or confirm the implied result in (3e) by repeating α to every follow up question, Q, on the topic.

Call the exchange in (3a) and (3b) 'round 1' and that in (3c) and (3d) 'round 2'. We now examine how S's responses after round 2 affect the Jury's estimate of his type and its interpretation of what he says. Although S repeats α 10 more times in the press conference from which our excerpt (3) is drawn, for simplicity of this analysis, we shall consider only rounds 3 through 5, for which S has three possible responses to each Q: *yes*, which is short for *Yes, the Senator has received gifts from his friend*; *no* which is short for *No, the Senator has never received gifts from his friend*; and α. The possible continuations for Sheehan that are relevant for the three rounds where *R* repeatedly poses different forms of Q are presented below in tabular form:

	round 3	round 4	round 5
σ_1	*yes*	–	–
σ_2	*no*	–	–
σ_3	α	*yes*	–
σ_4	α	*no*	–
σ_5	α	α	*yes*
σ_6	α	α	*no*
σ_7	α	α	α

Let $\mathbb{S} = \{\sigma_1, \sigma_2, \ldots, \sigma_7\}$. S represents the relevant possible set of plays, over which the Jury has a probability distribution. σ_7 is the actual case in which S responds with α to all instances of Q. An honest senator would have his spokesperson Sheehan respond with a *no* to the reporter's question eventually. To give a precise model for what happens following Asher and Paul (2017), we need some numbers. The belief function for Jury 1 assigns the following probabilities to the sequences of moves σ_n relative to the types t_H and t_D.

	σ_1	σ_2	σ_3	σ_4	σ_5	σ_6	σ_7
t_H	0	0.167	0	0.167	0	0.166	0
t_D	0.125	0	0.125	0	0.125	0	0.125

Notice that at the outset, the Jury accords an equal probability to t_H and t_D; the values on the rows above each sum up to .5.

We can now calculate how conversational moves can affect the Jury's assessment of S's type. In particular, we want to look at two "events", E_H and E_D, representing an honest senator vs. a dishonest senator and defined as follows:

$$E_H = \{t_H\} \times \mathbb{S}, \quad E_D = \{t_D\} \times \mathbb{S}$$

Now let's take a belief function β over the empty play or ULF ε as our starting point to model the beliefs of the Jury 1, which is of some type t_1, at the start of the press-conference.

$$\beta[\varepsilon](t_1)(E_H) = \beta[\varepsilon](t_1)(E_D) = 0.5$$

The Jury is thus equally unsure as to whether S is honest or dishonest. Recall that the Jury reverts to this distribution after round 2.

Let $\rho_1 = \langle \mathrm{Q} \rangle \langle \alpha \rangle$ be the play after round 2, i.e., after (3d). The strategies that are compatible with ρ_1 are $\mathbb{S}_1 = \{\sigma_3, \sigma_4, \sigma_5, \sigma_6, \sigma_7\}$. Hence, we can define the events

$$E_H(\rho_1) = \{t_H\} \times \mathbb{S}_1, \quad E_D(\rho_1) = \{t_D\} \times \mathbb{S}_1, \quad E(\rho_1) = E_H(\rho_1) \cup E_D(\rho_1)$$

Now,

$$\beta[\varepsilon](t_1)(E(\rho_1)) = 0.708$$

Let $j \in \{4,6\}$. Then we have, conditionalizing on the new event $E(\rho_1)$:

$$\beta[\rho_1](t_1)(\langle t_H, \sigma_j \rangle) = \beta[\varepsilon](t_1)(\langle t_H, \sigma_j \rangle \mid E(\rho_1)) = 0.167/0.708 = 0.238$$

and for $k \in \{3,5,7\}$

$$\beta[\rho_1](t_1)(\langle t_D, \sigma_k \rangle) = \beta[\varepsilon](t_1)(\langle t_D, \sigma_k \rangle \mid E(\rho_1)) = 0.125/0.708 = 0.175$$

Thus after round 3, the belief function of the Jury in Case 1, after Bayesian updates, can be represented in the following tabular form.

	σ_3	σ_4	σ_5	σ_6	σ_7
t_H	0	0.238	0	0.238	0
t_D	0.175	0	0.175	0	0.175

and we have $\beta[\rho_1](t_1)(E_H(\rho_1)) = 0.476$ and $\beta[\rho_1](t_1)(E_D(\rho_1)) = 0.525$

Next, let $\rho_2 = \langle \mathrm{Q} \rangle \langle \alpha \rangle \langle \mathrm{Q} \rangle \langle \alpha \rangle$ be the play after round 3, i.e., after (3f). The strategies that are compatible with ρ_2 are $\mathbb{S}_2 = \{\sigma_5, \sigma_6, \sigma_7\}$. As before, we can define the events

$$E_H(\rho_2) = \{t_H\} \times \mathbb{S}_2, \quad E_D(\rho_2) = \{t_D\} \times \mathbb{S}_2, \quad E(\rho_2) = E_H(\rho_2) \cup E_D(\rho_2)$$

and hence

$$\beta[\varepsilon](t_1)(E(\rho_2)) = 0.587$$

We have, as before

$$\beta[\rho_2](t_1)(\langle t_H, \sigma_6 \rangle) = \beta[\varepsilon](t_1)(\langle t_H, \sigma_6 \rangle \mid E(\rho_2)) = 0.238/0.587 = 0.404$$

and for $j \in \{5,7\}$

$$\beta[\rho_2](t_1)(\langle t_D, \sigma_k\rangle) = \beta[\varepsilon](t_1)(\langle t_D, \sigma_j\rangle \mid E(\rho_2)) = 0.175/0.587 = 0.298$$

Thus, $\beta[\rho_2](t_1)(E_H(\rho_2)) = 0.404$ and $\beta[\rho_2](t_1)(E_D(\rho_2)) = 0.596$. So after round 2, after Bayesian updates, the Jury believes even more that S has type t_D

The beliefs of the Jury about the type of S (and of the Senator) after each round of the conversation can be represented pictorially as follows.

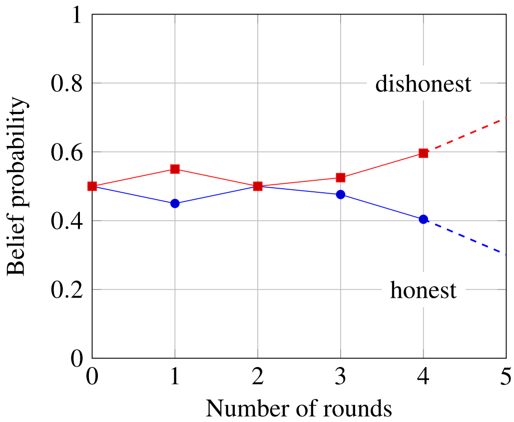

Figure 3

Given these calculations, we can imagine that such a Jury might then stop the conversation once the probability of t_D becomes high enough. For such a Jury, Sheehan's repetitions doom his play to be losing.

A key feature of our analysis is that the Jury's estimation of S's type also affects its *interpretation* of the conversation. The Jury's beliefs about the interpretation of what S says evolve as the Jury conditionalizes on events that are a combination of a new element of play as given in S and an assignment of types. The *yes* and *no* responses in the continuations to (3) would have an unambiguous interpretation as answers to the preceding occurrence of Q. The response α, however, is more problematic; what exactly is the role of α as a response to (3a)? And while α has a natural interpretation in (3d.i) as a Correction, subsequent repetitions of α are even less clear than its use in (3b). Consider, for instance, S's assertion of α as a response to R's question (3e), an affirmative answer to which should be a consequence, were α an indirect answer to (3a). While this and further instances of α could be attached with Background or Correction or with no specified relation at all, the probabilities of these histories given a play are vastly different depending on the type assignments.

To make things more concrete, let's focus just on the two histories we've considered in (5) and (6). Given Jury 1's belief function, repeating α to each variant of Q lowers the probability of t_H. But what does conditionalization do to the probabilities of h_1 and h_2? One plausible hypothesis is that the probability of h_1 covaries with the probability of t_H. Conditionalizing on events of the form $E_D(\rho_i)$ and $E_H(\rho_i)$ thus lowers the probability that repetitions of α after

(3d.i) are Correction moves that provide answers to Q and raises the possibility that they are uncooperative moves unconnected with R's questions. An honest Sheehan for this Jury would not have continued to make the α move as a Correction without further explanation. Once S continues to play α, the probability mass shifts more and more to the interpretation of α as a non-cooperative move.

In turn, conditionalization on the event of the interpretation $\hbar_1$ entrenches the Jury's belief that Sheehan is of type t_D. Thus, histories and types have an important co-dependence. A person's interpretation of a conversation can reinforce or change her beliefs about the players and or the Jury, which in turn may confirm or change how she shapes the history of the conversation.

Case 2: An alternative Jury, which is strongly predisposed to assign Sheehan t_H would have seen matters differently. Consider the following belief function for this Jury, in which the Jury already has a prior probability of .7 in t_H.

	σ_1	σ_2	σ_3	σ_4	σ_5	σ_6	σ_7
t_H	0	0	0	0.05	0	0.15	0.5
t_D	0.10	0	0.10	0	0.10	0	0

Such a Jury would have already accepted α as a perfectly acceptable indirect answer to (3a) and so opted for the history $\hbar_2$ for (3). It would also have constructed a different history for the rest of the conversation after (e). It would see each repetition of α as another correction of R's attempts to reopen a topic that Sheehan has already settled. Since S is of type t_H, he need not continue the discussion of a matter that has already been labelled as one that Sheehan will not comment on. Given this interpretation of the repetitions of α, the probability of t_H on the belief function for this Jury would remain high when the Jury conditionalizes upon that interpretation, and S has a winning strategy. See Figure 4 below.

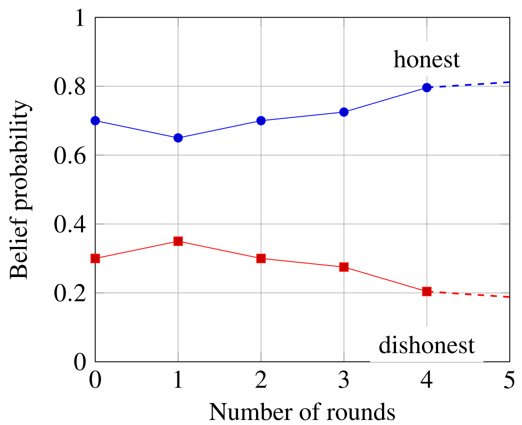

Figure 4

Given the continued high probability of t_H, conditionalizing on events of the form $\{t_H\} \times \mathbb{S}$ in turn assigns a high probability and confirms the continuation of history $\hbar_2$ in which S continues to correct R. Jury 2 conditionalizes on events like those defined in our analysis of Jury 1 but arrives at a very different conclusion; α is not interpreted as a non-cooperative move but as a Correction, and the updating of probabilities on types and on histories confirm each other.

The co-dependence between an interpreter's assessment of a speaker's type and his interpretation of what she says has several interesting consequences. The first is that *a priori* biases are easy in general to strengthen through interpretation. Furthermore, we have seen that bias is dependent on context. Hence, the model predicts that the more biased talk to which the Jury is exposed, the more it will carry this bias into the interpretation of future conversations. The moral is that interpretation is subject to manipulation. Although we have assumed that few components of discourse moves are ambiguous, our example illustrates that discourse connections, which are often ambiguous, can lead different Juries to very different conclusions.

This subjectivity goes even beyond language to the interpretation of "facts." Hunter et al. (2017) argue that interpreting non-linguistic events has significant parallels to interpreting conversation and that the two interact to produce a complete picture of a situation. If we couple this view with what we have developed here, our model implies that the interpretation of facts also naturally gives rise to a subjective bias. Figuring out the truth from a collection of facts described to suit someone's purposes is difficult.

The counterpart to this is that being a fair or impartial Jury, being open to other interpretations is not a natural outcome of conversational interaction. The model predicts that constraints exogenous to the natural way speakers interpret conversation and interpretation are needed to lead to an impartial assessment of conversational moves. So how do we ensure fair or unbiased interpretation for the Jury, or anyone else for that matter? This question links our question of assessment of conversational success with the present concern about the subjectivity of interpretation. One important parameter to fix are the types evoked to drive interpretation, as well as the probability distribution over them. In the model of Asher and Paul (2017), the types are simply abstract objects, devices for encoding probabilities about discourse histories and, indirectly, strategies. As such, the set of types is vast and uncountable. Yet typically, only certain types are relevant to interpretation. How do we determine an appropriate restricted set? Doing this also involves bias. To take an extreme case, if we only picked one type in our interpretation of (3), all the probability mass would align on that one type; conditionalization on new evidence would yield nothing new. A Jury considering just the one type would perforce be biased in the extreme and its views impervious to change.

A balanced or fair interpretation would thus need at least two types that are in an intuitive sense contraries of each other, as we have done in our treatment of (3). Moreover, one would need to start out with a balanced distribution over these types or at least be aware of the problems of bias coming from prior interactions. Nevertheless, we strongly suspect that having only two types is in general far from sufficient to arrive at the correct interpretations of conversational moves, and indeed, of the world around us.

4. Analyzing different types of content

A final illustration of the relevance of epistemic games to linguistics comes from the way speakers use *not at-issue* (NAI) information (Potts, 2005). Consider the following dialogue excerpt from the movie *The Princess Bride*, in which Wesley (W) has kidnapped Buttercup (B) and is questioning her about her fiancée Prince Humperdink (H). Buttercup and Wesley were once in love, but Wesley has disguised himself as a pirate, so Buttercup does not recognize him. They have just noticed their pursuers: Humperdink and his men.

(7) a. **B**: He (Humperdink) can find a falcon on a cloudy day, he can find you!
b. **W**: So you think your dearest love will save you?
c. **B**: I never said he was my dearest love and yes, he will save me. That I know.
d. **W**: You admit to me that you do not love your financé?
e. **B**: He knows I do not love him.

As a background to (7), it is clear from the context that Wesley's goal is to determine Buttercup's feelings for Humperdink while concealing his identity. Concealing his identity is important because Buttercup would have good reason to hide her love for Humperdink from Wesley.

Wesley uses a presupposition in (7b), a form that conveys NAI content, to try to discern whether Buttercup loves Humperdink. As many linguists have noted, NAI constructions do not admit of simple rejoinders; Buttercup cannot take issue with the presupposition that Humperdink is her dearest love with a simple 'no', 'I disagree', or 'that's not true'. Getting Buttercup to reveal her type in this situation involves a more complicated strategy than simply asking directly if she loves Humperdink. Why does Wesley choose such a strategy? Why does he pretend to play along with Buttercup's apparent conversational goal—to convince Wesley that he should let her go because he is going to be caught—when he isn't actually interested in it?

We believe epistemic ME games can help clarify matters, but first, we need some background assumptions. We follow Hunter and Asher (2016)'s discursive, SDRT analysis of NAI content according to which NAI content results from the way that an utterance contributes to a hierarchical discourse structure. At any given point in a discourse, certain discourse moves will be more salient and easier to build off of than others. The set of salient discourse units, referred to as *The Right Frontier* in various discourse theories, will evolve as a discourse proceeds in a way that is subject to general discursive principles. Hunter and Asher's central claim is that utterances that involve multiple discourse units, which they argue must be the case when an utterance contains both NAI and AI content, have their own internal discursive structure, and the same general discursive principles that determine whether other discourse units are on the Right Frontier or not also determine which parts of a multi-part utterance are on the Right Frontier and therefore salient. Speakers exploit these principles to make certain parts of their utterances easier to build off of than others. Those parts that are on the Right Frontier will be at-issue (so long as they are on the RF); those that are not will be NAI. In SDRT, presupposed content is attached to a position off the Right Frontier (Asher and Lascarides, 1998); the presupposition of (7b) is therefore NAI, as desired. With Buttercup's correction in (7c) and Wesley's subsequent follow-up in (7d), however, the discourse shifts seamlessly to one in which the presupposed content is placed back on the Right Frontier and thereby made at-issue.

With this background in place, let's look more closely at the discourse structure of (7) and its interaction with conversational goals. Suppose that Buttercup is of one of two types: either she loves H and is of type t_l, or she does not and is of type t_n. We will suppose that in either case, she is not interested in dissembling her type. Wesley's conversational goal can be formulated as getting Buttercup to reveal whether she is of type t_n or type t_l while concealing his type. We assume further that after (7a), Wesley has the option of using (7b) with the NAI device or asking the direct question DQ: *Do you love Humperdink?*. In the context of (7a) and the more general pursuit by Humperdink and his men, DQ would blatantly shift the topic and naturally arouse suspicions: why would an unknown pirate care about Buttercup's affections for Humperdink? There is a high probability that Buttercup would fashion a conversational continuation—e.g., *why should YOU care about that?*—that would endanger Wesley's goal of concealing his identity. By opting for an NAI construction, Wesley makes *Buttercup* responsible for the shift in discourse topic, which is less likely to arouse suspicion.

The expected utility of DQ is thus lower than that of (7b) when it comes to achieving Wesley's goal of concealing his identity. This goal in turn serves the larger goal of determining Buttercup's type. Buttercup would have no obvious reason to hide her love for Humperdink from a total stranger, especially a stranger who knows that she is engaged to Humperdink. On the other hand, her old feelings for Wesley, whom she believes at this point to be dead, might give her reason to be less than forthcoming with him. Buttercup's rejection of the NAI content in (7b) is more significant, and therefore more useful for determining Buttercup's type, if she does not realize she is talking to Wesley. Thus the NAI device in (7b) has a higher expected utility for Wesley's primary goal as well.

Now suppose that Buttercup had been of type t_l and had not questioned the NAI content, responding only to the AI content with something like, *Yes, he will save me* (Sv). By conditionalizing on Sv, which entails Buttercup's acceptance and public commitment to the NAI content[6], the probability that Buttercup is of type t_l is plausibly high. The NAI construction would be helpful in this case as well, because it would allow Wesley to cut his losses and infer that Buttercup's romantic allegiances had shifted, another way of obtaining his winning condition.

We have illustrated one example of a strategic use of NAI content, but there are many others (see Hunter and Asher, 2016). In each of these cases, NAI constructions are strategically useful when a speaker s_0 has a conversational goal that he wishes to conceal. Our model predicts this strategic use of NAI devices if we make the reasonable assumption that a move by s_0 to place a bit of content ϕ on the Right Frontier as a topic for discussion raises the probability that s_0 has a conversational goal of getting a commitment from his interlocutor, s_1, to ϕ or $\neg\phi$. Someone wanting to conceal his desire to extract such a commitment will be better off placing ϕ in an NAI position. In this case, he can still get the commitment he seeks: if s_1 continues

[6]Wesley's use of a presupposition should not entail that Buttercup commits to its content, but once she opts to build on Wesley's structured discourse contribution, she commits herself to the whole of both its content and its structure. See Hunter and Asher (2016) for more details.

the conversation without disputing ϕ, s_1 commits to the content of ϕ. Conversely, if s_1 does dispute ϕ,[7] then she may reveal information to s_0 without s_0 making ϕ discourse salient.

We formalize the strategic use of NAI content in Proposition 1. Recall that $\Diamond\phi$ is true on a conversational string just in case ϕ is true at some stage in the conversation; let $C_1\phi$ stand for 's_1 commits to ϕ,' and let '$\models$' stand for the satisfaction relation defined over the basic exogenous semantics for plays in $(V_0 \cup V_1)^\infty$ (for details, see Asher et al., 2016). Let ρ_n for $\rho \in (V_0 \cup V_1)^\infty$ be a prefix of length n of ρ and let β_1 be the belief function for a fixed type of s_1. Let t_ϕ be a type of s_0 whose winning condition includes a move that commits s_1 to ϕ. Let ε be the empty play in $(V_0 \cup V_1)^\infty$.
Proposition 1. *Let G be an ME game with* $Win_0 \subseteq \{\rho \in (V_0 \cup V_1)^\infty : \rho \models \Diamond C_1\phi\} \cap \{\rho \in (V_0 \cup V_1)^\infty : \neg\exists n \beta_1[\rho_n](t_\phi) > \beta_1[\varepsilon](t_\phi)\}$. *Then if* 0 *has a winning strategy* σ *in G,* σ *will include a use of an NAI device for conveying a question about* ϕ *instead of an AI device for conveying* ϕ.

Hunter and Asher (2016) argued that the NAI status of a bit of content ϕ cannot be attributed to syntactic and semantic features of ϕ alone; its status is ultimately determined by how ϕ attaches to a larger discourse structure. Our discussion here makes a similar point about conversational goals: the nature of a goal cannot be recovered directly by considering the at-issue status of content in the discourse; its nature is ultimately determined by the larger discourse structure or history. In particular, we cannot assume that the difference between AI and NAI content is that AI content directly addresses a conversational goal while NAI content plays some secondary, supporting role relative to conversational goals, contra claims made in by Roberts (2012) and Simons et al. (2010) *inter alia*. If we consider only (7a)-(7c), then it is true that Wesley's apparent conversational goal aligns with the AI content of his utterance in (7b); that is, it seems that he shares Buttercup's goal to determine whether Humperdink will catch him. However, once we consider the longer string including not only (7d) and (7e), but also Wesley's subsequent questioning of Buttercup, then we understand that his actual goal is more accurately reflected by his NAI moves. Even if Buttercup is not immediately aware of this actual conversational goal, the audience of the film, acting as a Jury, can see this clearly.

5. Conclusions and future work

We have elaborated some consequences of using ME games for linguistic analysis, consequences that we think touch on important issues in pragmatics and semantics. We have shown how a notion of conversational success and a precise definition of conversational goals can affect the discourse structure of a dialogue. We have also shown how to add epistemic considerations to discourse interpretation, which has allowed us to formulate an analysis of the power and the limits of subjectivity in interpretation. We have further shown how the framework of epistemic ME games yields an analysis of bias, its ubiquity and its effects on interpretation. At the same time, we have argued that there are limits to bias; one cannot arbitrarily reinterpret unambiguous messages to mean something different from what they normally mean.

Another very important issue that we leave for future work concerns the notion of a fair or "unbiased" interpretation, something of interest not only to linguists but the general public at

[7]For an account of corrections, see Asher and Lascarides (2003).

large. While such a notion has an intuitive meaning, working out a precise analysis within a framework like epistemic ME games requires an analysis of the types relevant to such an interpretation. We also feel that fair interpretations are hard. Given that a fair interpretation is a conversational goal, our framework can actually tell us precisely how hard it is, but we do not know at present the complexity of such a goal nor even how to formulate it precisely.

Another application of epistemic ME games that we find linguistically interesting is their use in analyzing the strategic uses of vehicles of content that affect discourse salience or that introduce content without affecting salience. To this end, we have given a preliminary analysis of the strategic usefulness of not at-issue expressions of content. Future work will aim to improve this analysis with more case studies and a more careful taxonomy of expressions that affect discourse salience.

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Obligatory Additives in the Antecedent of Conditionals

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Abstract. The paper investigates the obligatory insertion of additive particles in the antecedent of conditionals. Two theories are compared with regard to their different predictions regarding this insertion. One theory works with the principle *Maximize Presupposition* (Heim, 1991), the other postulates a relation between mandatory exhaustivity inferences and insertion of additive particles (Bade, 2016). The first theory predicts additives to be obligatory under downward entailing (DE) operators which are holes for presuppositions. The second theory predicts the insertion of additives to not be obligatory under DE-operators due to the fact that exhaustivity inferences are usually blocked in these environments for independent reasons (Chierchia et al., 2012). Previous studies already suggest that additives (and iteratives) are not obligatory under negation, contrary to the predictions of *Maximize Presupposition* (Bade and Tiemann, 2016). In the present paper, an experimental study on the insertion of German "auch" in antecedent of conditionals is reported which tests the predictions of both theories and further confirms an account of obligatory additivity working with *Obligatory Implicatures*.

Keywords: presuppositions, conditionals, implicatures.

1. Introduction

The paper investigates the obligatory insertion of additive particles in the antecedent of conditionals. Previous studies on obligatory presupposition triggers suggest that additive particles do not fall in the class of triggers whose obligatory insertion follows from the principle *Maximize Presupposition* (Bade, 2016). Rather, the data suggest that additives are inserted to block or cancel exhaustivity implicatures. One important prediction of *Maximize Presupposition* is that presupposition triggers are obligatory in contexts which are holes for presuppositions, such as under negation and in the antecedent of conditionals. It has been shown that additives are not obligatory under negation (Bade and Tiemann, 2016). This is straightforwardly explained under an account working with *Obligatory Implicatures*. Since exhaustification is blocked under negation for independent reasons, insertion of the trigger is unnecessary. The study presented here tested the predictions of *Maximize Presupposition* and the competing theory *Obligatory Implicatures* for the insertion of additives in antecedents of conditionals. The results show that additives are generally not obligatory in this environment. Moreover, the data suggest that the insertion of additives interacts with the interpretation of the conditional as a whole. The study is thus also revealing with regard to the ongoing question under which circumstances exhaustivity implicatures occur locally.

Section 1 gives the theoretical background, specifically it discusses the two theories *Obligatory Implicatures* and *Maximize Presupposition*. In section 2 an acceptability rating study on German "auch" in antecedent of conditionals is presented which tested the predictions of the two theories.

2. Theoretical Background

Presupposition triggers are obligatory when their presupposition is fulfilled in the context, see examples in (1) (Heim, 1991; Sauerland, 2008; Percus, 2006; Chemla, 2008).

(1) a. The / # A father of the victim arrived.
b. Bob came to the store. Bill came, #(too).
c. Peter went to Norway this year. He went to Norway #(again) last year.
d. John # believes / knows Paris is in France.

There are two approaches to the phenomenon of obligatory presuppositions, one is working with the principle *Maximize Presupposition*, the other makes use of *Obligatory Implicatures*. Previous experimental findings suggest that presupposition triggers fall into two classes with regard to their obligatory insertion. The insertion of one set of triggers is better captured using *Maximize Presupposition*, the insertion of the other group seems to follow from *Obligatory Implicatures*. Both theories predict the insertion of the triggers in (1) to be obligatory. Theories working with *Maximize Presupposition* assume that there is lexical competition between the trigger and its non-presuppositional counterpart, which are ordered on a scale, see examples in (2).

(2) Scales: {the, a}, {both, every}, {believe, know}, {again, $\emptyset$ }, {SG, PL}, {too, $\emptyset$ }, {PRES, PAST}

Using the weaker item on this scale of presuppositional strength will lead to an "anti-presupposition" or "implicated presupposition", i.e. the inference saying that the presupposition of the stronger competitor is false. The inference arising from using (3a) instead of (3b), for example, is that it is not certain that there is a unique 6ft long catfish, see (3c).

(3) a. Robert caught a 6ft long catfish.
b. Robert caught the 6ft long catfish.
c. $\neg\exists$x.$\forall$y.6ft-catfish(y) $\leftrightarrow$ x =y

Parallelly, (4a) has an inference that it is not certain that the victim has one unique father, which contradicts common knowledge. As a result, the definite determiner is obligatorily inserted. "Antipresuppositions" (Percus, 2006) are argued to have a special status. First, these inferences are said to be projective content, a property they share with presuppositions. Since the negated (4a) has the presuppositional stronger competitor in (4b) the same undesired inference arises that the presupposition of (4b) is false, see (4c). As a result the definite must be inserted under negation.

(4) a. #A father of the victim did not arrive.
b. The father of the victim did not arrive.
c. $\rightsquigarrow$ $\neg\exists$x.$\forall$y.father-of-victim(y) $\leftrightarrow$ x =y

Another property is that these inferences usually resist strengthening. That is, the inference in (3a) cannot be strengthened to "It is certain that there is more than one 6ft long catfish", as would be expected if they were implicatures.

However, it has been observed that not all presupposition triggers behave alike when it comes to their obligatory insertion. Specifically, it has been shown that the inferences from not using presupposition triggers other than the definite determiner do not necessarily come with the features just discussed. First, it has been argued that some of the "antipresuppositions" can be strengthened in the same way as implicatures (Chemla, 2008). The sentence with "believe" in (5), for example, has a strong inference that it is certain that the speaker does not have a brother. This is because speakers are usually opinionated when it comes to them having siblings or not.

(5) Jane believes I have a brother.

Second, the presupposition triggers "too" and "again" (German "auch" and "wieder") are not obligatory under negation, which shows that their "antipresuppositions" do not project, see examples in (6) below (Bade and Tiemann, 2016).

(6) a. Yesterday Jenna went ice-skating. Today she did not go (again).
b. Bob came to the party. It is not true that John came, (too).

Moreover, the circumstances under which the trigger "too" is inserted seems to align with the circumstances under which exhaustivity implicatures arise. The more pressure to derive an exhaustivity implicature, the more pressure to insert the trigger (Bade, 2014, 2016). These facts are more compatible with a theory that assumes that obligatory insertion of the presupposition trigger follows from *Obligatory Implicatures*.

The theory assumes that the (b) sentences in (7)-(9) have implicatures, given in (c) respectively, which are contradictory to the contexts in (a).

(7) a. Paris is in France.
b. Mary believes$_F$ that Paris is in France.
c. It is not certain that Paris is in France.

(8) a. John has visited Rome.
b. Peter$_F$ has visited Rome.
c. Peter is the only one who has visited Rome.

(9) a. Mary came to John's party last year.
b. She came to John's party this year$_F$.
c. This year is the only time Mary came to John's party.

These implicatures are derived by a covert exhaustivity operator, see definition in (10) (Fox, 2007), which evaluates the focus, for example on "Peter" in (8b). One further assumption is that, in the absence of other overt alternatives, the Question Under Discussion (QUD, Roberts

(1996)) which matches the focus provides the set of alternatives (Bade, 2016). The derivation of the exhaustivity implicature is given in (11).

(10) a. $[\![\text{EXH}]\!](A_{<<s,t>,t>})(p_{<s,t>})(w) \Leftrightarrow p(w)\ \&\ \forall q \in NW(p, A): \neg q(w)$
b. $NW(p,A) = \{q \in A: p \text{ does not entail } q\}$

(11) $[\![[\ [\ \text{EXH Q}\ ]\ [\ \text{Peter}_F \text{ has visited Rome}\ ]\ ]]\!]$ = Peter was in Rome in w & $\forall q[q \in [\lambda p.\exists x.\ p= \lambda w.\ x \text{ was in Rome in } w\ ]\ \&\ p \not\Rightarrow q \rightarrow q(w) = 0\ ]$

This theory does not predict triggers to be obligatory under negation since exhaustivity is blocked here for independent reasons (Bade and Tiemann, 2016). Moreover, the inferences arising from not using the trigger are supposed to be implicatures, which explains that they are dependent on context and can be strengthened (Sauerland, 2004).

The empirical picture arising so far is that presupposition triggers fall into two classes with regard to obligatory insertion (Bade, 2016). One set of triggers, including the definite, is better captured by *Maximize Presupposition* since inserting it is obligatory below DE-operators and its insertion does not depend on the context, especially the QUD. Another set of triggers, including "know", "again" and "too", follow from *Obligatory Implicatures*. Leaving them out creates implicatures which can be contradictory to the context and do not arise under DE-operators.

3. Experimental Study

3.1. Idea: presupposition triggers in antecedents of conditionals

Maximize Presupposition predicts presupposition triggers to be obligatory in antecedents of conditionals since they are holes for presuppositions. That is, the presupposition of "again" in (12a) that Peter was in Norway before projects out of the if-clause in (12b).

(12) a. Peter was in Norway again this year.
b. If Peter was in Norway again this year, he was fishing.

As a result, if (13a) is used instead of (12b), which is the presuppositionally stronger competitor, the "anti-presupposition" in (13b) arises that the presupposition of the competitor is false.

(13) C: Peter was in Norway last year.
a. If Peter was in Norway this year, he was fishing.
b. $\rightsquigarrow$ It is not true that Peter was in Norway before.

Due to this inference, (13a) is predicted to be degraded in the context given in (13) which establishes that Peter was in Norway before by *Maximize Presupposition*.

According to *Obligatory Implicatures* the insertion of the presupposition trigger should only be forced if an exhaustivity implicature arises which is contradictory to the context. The question thus is: what exactly are the exhaustivity implicatures that arise with if-clauses? There is evidence from scalar implicatures that exhaustivity implicatures arise below the if-clause. The sentence in (14) is ambiguous between the reading in (14a) and the one in (14b).

(14) If you have salad or dessert, you pay $20.
  a. If EXH you have salad or dessert, you pay $20.
  'If you have salad or dessert but not both you pay $20.'
  b. If you have salad or dessert, you pay $20.
  'If you have salad or dessert or both, you pay $20.'

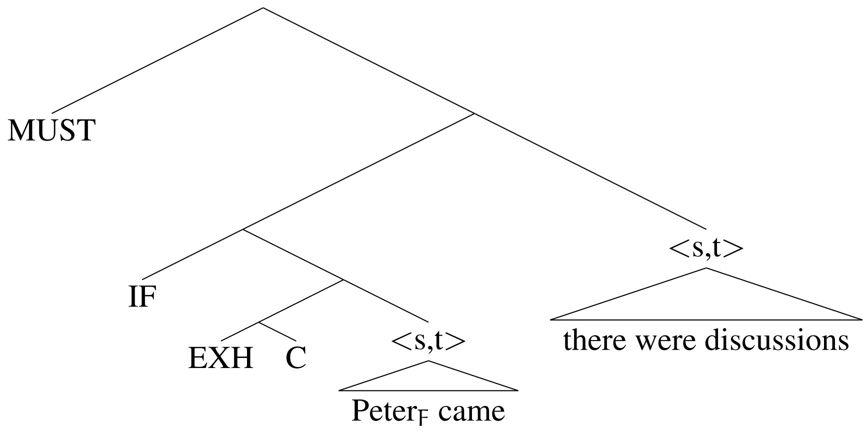
Since the scale ordering the items {or, and} (Horn, 1984) is reversed under downward-entailing operators the sentence in (14b) is already the strongest competitor. Adding an exhaustivity operator below "if" usually would not lead to strengthening and thus is ruled out on the basis of the economy condition (Chierchia et al., 2012). Readings such as the one in (14a) are available, but are argued to require special circumstances and usually pitch accent on the scalar item (Fox and Spector, to appear).

For sentences with particularized conversational implicatures yielded by focus, such as the one in (15), the picture looks very similar. There are two exhaustification strategies, given in (15a) and (15b) and both seem available.

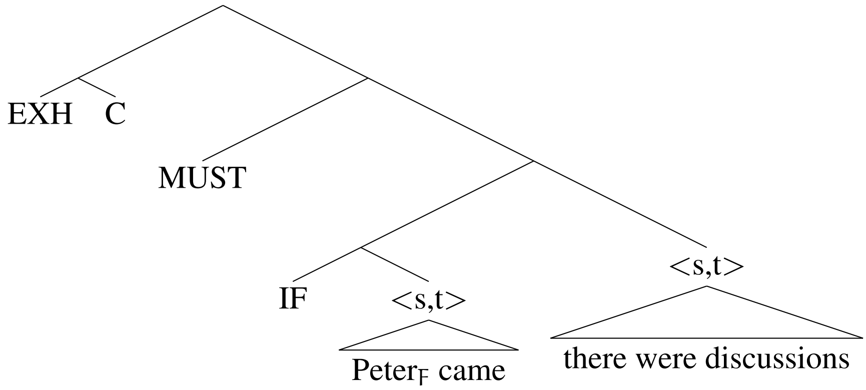
(15) If Peter_F came, there were discussions.
  a. If EXH Peter came, there were discussions.
  b. EXH If Peter came, there were discussions.

The LF for (15a) is given below in (16), the one for (15b) is given in (17).

(16)



(17)



Let us assume that the context in which (16) is uttered is the one in (18).

(18) Mary came.
  a. If EXH Peter_F came, there were discussions.
  b. EXH If Peter_F came, there were discussions.

The relevant alternatives for (18a) are propositions of the form given in (19).

(19) Alt = {Peter came, Mary came, Peter and Mary came, ...}

If the exhaustification strategy in (18a) is chosen, both alternatives "Mary came" and "Mary and Peter came" are excluded since they are non-weaker and the reading in (20) is yielded. Assuming that a epistemic (realistic) modal base is chosen for the covert modal which is restricted by the if-clause this reading yields a contradiction (Kratzer, 1991).

(20) $\forall$w $\in$ {w': w' is compatible with the evidence available in the utterance situation in $w_@$ } & Peter came in w & Mary did not come in w $\rightarrow$ there were discussions in w

'If Peter and not Mary came, there were discussions.'

Since it is already established in the context that Mary came the indicative conditional with a low EXH operator must be perceived as contradictory. There is no possible world in accordance with the facts of $w_@$, the actual world, where Mary did not come. With the exhaustification strategy in (18b) the relevant alternatives are the one in (21).

(21) Alt = {If Peter came, there were discussions; If Mary came, there were discussions; If Peter and Mary came, there were discussions ...}

The sentence in (18b) entails that if Peter and Mary came there were discussions. The only alternative which is non-weaker and thus excluded is that if Mary came there discussions, see the interpretation of (18b) in (22).

(22) $\forall$w $\in$ {w': w' is compatible with evidence available in the utterance situation in $w_@$} & Peter came in w $\rightarrow$ there were discussions in w & $\neg$ $\forall$w $\in$ {w': w' is compatible

with the evidence available in the utterance situation in $w_@$} & Mary came in w $\rightarrow$ there were discussions in w
'If Peter came there were discussions and not if Mary came there were discussions.'

This reading says that Peter's coming is the condition for there being discussions and not Mary's coming. This is not contradictory to the fact that Mary came. There is, of course, a third option where no exhaustivity operator is inserted into the structure. This reading is also predicted to not yield any inferences which could be contradictory to the the discourse. Only if the first option with EXH $<$ If is chosen, the trigger should be obligatory according *Obligatory Implicatures*. Since this reading is predicted to be marginally available, leaving out the trigger should be fine in most cases.

To sum up, the theories make different predictions with regard to the insertion of presupposition triggers in antecedents of conditionals. For *Maximize Presupposition* the trigger should be obligatory as long as its presupposition is fulfilled. According to *Obligatory Implicatures*, the trigger is only obligatory if exhaustification leads to a contradiction with the context. This can only happen when an exhaustivity operator is inserted below "if". A correlation between interpretation and pressure to insert the trigger is thus predicted. The purpose of the study presented was to test these predictions.

3.2. Material and Design

The idea behind the study was to test the predictions of the two theories *Maximize Presupposition* and *Obligatory Implicatures* regarding the obligatory insertion of the German additive particle "auch" in the antecedent of conditionals. The design of the study was simple. There was a context establishing that the presupposition of the additive was fulfilled, see the example in (23).

(23) Teresa, Sabrina und Isa gehen in die selbe Klasse und haben gerade eine Klausur zurück bekommen. Sabrina sagt zu Teresa: Ich bin durch die Klausur gefallen. Theresa antwortet:
Teresa, Sabrina and Ida are students in the same class and just got back an exam. Sabrina says to Theresa: I failed the test. Theresa replies:

The target sentence was following the context and appeared in two conditions with and without the additive (+ADD/-ADD).

(24) a. Wenn Ida auch durchgefallen ist, muss der Test schwer gewesen sein.
If Ida also failed the test, the test must have been hard. **+ADD**
b. Wenn Ida durchgefallen ist, muss der Test schwer gewesen sein.
If Ida failed the test, the test must have been hard. **-ADD**

Participants were asked to read context and target sentences carefully and then judge the acceptability of the target in a given context on a scale from 1 to 5 (where 5 stands for totally acceptable). To test the prediction of *Obligatory Implicatures* that the insertion of the trigger is only obligatory under a certain interpretation participants were moreover asked two comprehension questions. The first question addressed the interpretation of the antecedent, an example is given in (25). Participants could choose between three answer options given in (25a-c).

(25) **Q1: According to Teresa, under which conditions must the test have been hard?**
   a. Sabrina failing (IF A)
   b. Ida failing (IF B)
   c. Both Ida and Sabrina failing (IF A and B)

The second question people were asked aimed at finding out whether there are inferences resulting from using the conditional which could yield contradictions, an example is given in (26). They had three options for answering, given in (26a-c).

(26) **Q2: Does Theresa believe that Sabrina failed?**
   a. Yes (Y)
   b. Unclear (U)
   c. No (N)

The answers to these two questions together were supposed to tell which interpretation people had in mind when judging the acceptability of the sentences. Especially interpretation question number two was supposed to give insights into whether the sentence without the additive was perceived as contradictory to the previous discourse, i.e. whether there was an inference (antipresupposition or implicature) that created a contradiction. With the additive, the sentence should make clear that the speaker (Teresa in the example given) believes that Sabrina failed, the answer to Q2 should thus clearly be "Yes". However, it is not clear from the sentence with the additive that the speaker considers both Sabrina's and Ida's failing conditions for the test being hard, i.e. the sentence with "auch" is ambiguous between the two readings in (27).

(27) If Ida failed too, the test must have been hard.
   a. $\forall$w $\in$ {w': w' is compatible with the evidence available in the utterance situation in $w_@$} & Ida failed in w & Sabrina failed in w $\rightarrow$ the test was hard in w
   If both Ida and Sabrina failed, the test must have been hard.
   b. $\forall$w $\in$ {w': w' is compatible with the evidence available in the utterance situation in $w_@$} & Ida failed in w $\rightarrow$ the test was hard in w
   If Ida failed, the test must have been hard.

The reading in (27b) is considered to be less prominent but available. It said that only Ida's failing is a necessary condition for the test being hard (but presupposes that Sabrina failed). The contexts were set-up in a way that principally allowed for both readings. No matter which one of the two was chosen, however, the acceptability of the sentence should not be affected by since they both do not lead to a contradiction. The more interesting question was which readings arose for the sentence without the trigger. If a reading was yielded which was contradictory to the previous discourse the difference in acceptability between the sentence with and without the trigger was assumed to be significant according to *Obligatory Implicatures*. Compared to that, the differences between acceptability of the sentence with and without the trigger should not reach significance if the sentence without the trigger was not considered being contradictory. The reading which yields a contradiction is one where the exhaustivity is inserted below "if" (IF > EXH). This reading requires the participants to answer that only Ida's failing is a condition for the test being hard (Q1= If B). In addition, the sentence should imply that Teresa is unsure that Sabrina passed (Q2= No). One reading which is not contradictory to the previous sentence is one where the exhaustivity operator is inserted above "if" (EXH > IF). This reading is supposed to be reflected by participants saying that only Ida's failing is a condition for the test being hard (Q1 = IF B), but in addition the speaker has no doubt that Sabrina failed too (Q2 = Yes). This reading is thus the same as the one in (27b) and available with and without "too". The last reading does not involve any exhaustivity operator and is also not contradictory to the discourse; it is one where both Ida's and Sabrina's failing are considered conditions for the test being hard (Q1= If A and B) and the sentence is not perceived as a contradiction to the fact that Sabrina passed (Q2 = Yes). This reading is the one in (27a) and should hardly be available without the additive. The interpretations corresponding to the combination of answers given to Q1 and Q2 are summarized in figure 1 below.

Answer(s)	Interpretation
Q1= IF B and Q2 =No	If only B then C (**IF > EXH)**
Q1= IF B and Q2 =Yes	Only if B then C (**EXH > IF)**
Q1 = IF A and B and Q2=Yes	If A and B then C (**#EXH)**

Figure 1: Interpretations corresponding to answers

3.3. Predictions

Maximize Presupposition predicts sentences with the additive to overall be judged more acceptable than sentences without the additive in contexts which verify its presuppositions. This is because the sentence in (28a) in the context of (28) has the competitor in (28b). Not using this competitor should, through pragmatic reasoning, lead to hearer to calculate the "antipresupposition" in (28c), saying that the presupposition of (28b) is false.

(28) Sabrina failed.
  a. If Ida failed the test was hard.
  b. If Ida failed too, the test was hard.
  c. $\neg\exists p \in C$ & $p \neq$ Ida failed & $p(w) = 1$

The inference in (28c) is contradictory to the fact that Sabrina failed. The sentence without the additive should thus be unacceptable in the context. Calculating this inference is supposed to be the default interpretation in the given context since the competition with "too" is made prominent by the overt alternative "Sabrina failed". The prediction would thus be that sentences without the additive are most often interpreted as denying the truth of (28), which would result in a high percentage of "no" answers to Q2. If, however, no such inference ("antipresuppositions") arises the sentence should be judged acceptable without the trigger.

According to *Obligatory Implicatures* the sentence without the trigger should be less acceptable than the sentence with the trigger only if an exhaustification strategy is chosen which yields a contradiction. This is only the case if the exhaustivity operator is inserted below "if" (IF > EXH). The question under which circumstances exhaustification is mandatory versus optional is still open. However, some preferences for which exhaustivity implicatures arise in conditionals can be determined based on the research on scalar implicatures (Chierchia et al., 2012; Fox and Spector, to appear). Under the assumption that exhaustification below downward-entailing operators usually requires contextual pressure and pitch accent on the relevant alternative trigger, the exhaustification strategy which yields the contradiction (IF > EXH) should be the least likely interpretation. If one adopts the view that inserting EXH is the default if it leads to strengthening, the interpretation with EXH above "if" should be the most frequent one (EXH > IF). As a result, the insertion of the trigger in antecedents of conditional is considered not obligatory since the interpretation which triggers the insertion is a very marginal one (at least in the contexts used in the experiment). As *Maximize Presupposition*, *Obligatory Implicatures* predicts no decrease of acceptability for sentences without the trigger which do not yield a contradictory inference. The predictions of both theories are summarized in figure 2 below.

Interpretation	Predictions ObligImp	Predictions MaxPres
If only B then C (**IF > EXH**)	FREQUENCY LOW, ACCEPT +ADD > ACCEPT -ADD	FREQUENCY HIGH, ACCEPT +ADD > ACCEPT -ADD
Only if B then C (**EXH > IF**)	FREQUENCY HIGH, ACCEPT +ADD = ACCEPT -ADD	FREQUENCY LOW, ACCEPT +ADD = ACCEPT -ADD
If A and B then C (**#EXH**)	FREQUENCY LOW, ACCEPT +ADD = ACCEPT -ADD	FREQUENCY LOW, ACCEPT +ADD = ACCEPT -ADD

Figure 2: Interpretations corresponding to answers

3.4. Analysis and Results

One factor was manipulated for the study creating two conditions: the target items were conditionals which either were presented with or without the German additive "auch" in a context which satisfied its presupposition (+/-ADD). There were three dependent variables: the acceptability of the sentence on a Likert scale (1-5), and the answers to two comprehension questions. Six experimental items were created per condition, which made for 12 experimental items in total. 24 filler items were used. 24 German native speakers, students or former students of the university of Tübingen participated in the experiment, they received 5 Euros for their participation.

Results were analyzed with linear mixed effect models using the lmer function in R (Bates, 2005). The fixed factor was ADDITIVE, random factors were subject and items. The analysis revealed a significant effect of ADDITIVITY on acceptability. The insertion of the additive decreased acceptability of the conditional, see figure 3.

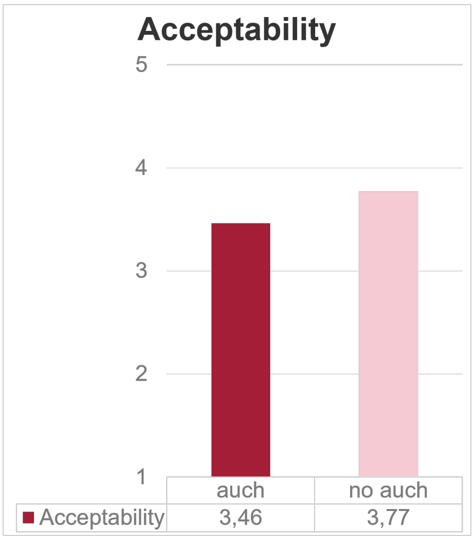


Figure 3: Acceptability of sentences with and without additive

Moreover, the additive had a marginally significant influence on which interpretation was chosen in response to Q1 ("What are the conditions for the event described by the consequent? IF A, IF B, IF A and B?) (p<.08): with "auch" more "both" (IF A and B) responses were chosen. "Auch" also had a significant influence on choice of interpretation for Q2 (Does the speaker believe the previously mentioned fact that A occurred? YES, NO, UNSURE) (p<.01), more "no" answers were given with the presence of the additive. Since the analysis revealed that pooling "yes" answers with "unsure" answers or pooling "no" answers with "unsure" answer did not affect the analysis, the interpretations "yes"/"uncertain" were pooled together as suggesting no contrast to previous discourse, whereas "no" responses were considered as suggesting a contrast/contradiction to previous discourse. Overall, using the additive increased percentage of interpretations without any exhaustivity operator (#EXH, no contrast + IF A and B response), it decreased percentage of interpretations with high EXH (EXH>IF, no contrast + If B response) and increased interpretations with low EXH (IF>EXH, contrast and IF B response) see figures 4 and 5.

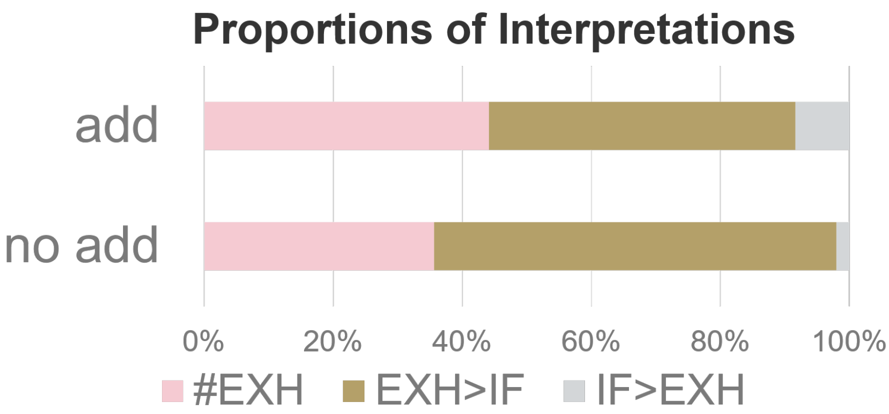


Figure 4: Proportion of interpretations chosen with and without additive

	#EXH	EXH>IF	IF>EXH
-ADD	35,7%	62,3%	2%
+ADD	44,2%	47,4%	8%

Figure 5: Proportions of interpretations chosen with and without additive

The responses to Q1 and Q2 both have a significant influence on acceptability (Q1 p<.05, Q2 p<.01). Comparing different models using a chi-square test revealed that the best model for predicting acceptability included both the factor ADDITIVITY as well as responses to Q1 and Q2. A causal mediation analysis furthermore showed that both responses had an influence on acceptability which was not influenced by the presence of the additive.

The interpretation without any exhaustivity operator (#EXH) is significantly more acceptable overall (M= 4,15) than the interpretation involving high or low exhaustivity operators (IF>EXH, M= 3,25; EXH>IF, M= 2,8). The interpretation with no EXH got even more acceptable with the presence of the additive, however the difference was not significant. The interpretations where there was either a low or high EXH got less acceptable with the presence of the additive, see proportions of interpretations in figures 6 and 7. This difference was only significant for the interpretation with EXH > IF.

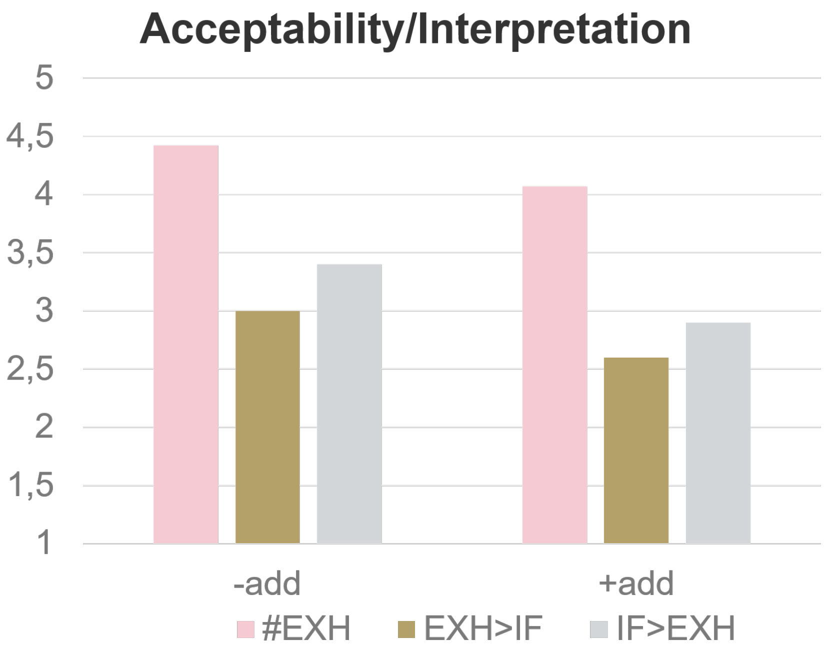


Figure 6: Acceptability by interpretation chosen with and without additive

	#EXH	EXH>IF	IF>EXH
-ADD	4,42	3	3,4
+ADD	4,07	2,6	2,9

Figure 7: Acceptability by interpretation chosen with and without additive

3.5. Discussion

As predicted by *Obligatory Implicatures* the percentage of interpretations which were perceived as contradictory to the discourse was low (<5%). This is in line with the assumption that the inference arising when the trigger is not inserted is an exhaustivity implicature, which only occurs below DE-entailing operators under special circumstances. This is because under normal circumstances it yields to weakening of the statement. The inference resulting from the LF in (29) leads to the weaker statement in (29a) which is entailed by the stronger LF without EXH, see (29b).

(29) If EXH Peter came, there were discussions.
Alt = {Peter came, Mary came, Peter & Mary came}
a. If Peter and not Mary came, there were discussions.
b. If Peter came there were discussions.
⇒ If Peter and Mary came, there were discussions.
⇒ If Peter and not Mary came, there were discussions.

Usually these circumstances where EXH is inserted below DE-operators involve pitch accent on the scalar item and are analyzed using stacked exhaustivity operators (Fox and Spector, to appear). Since the implicatures discussed in this paper are particularized conversational implicatures, not generalized ones, their occurrence might be even more restricted under DE operators. Since the sentences were only read by participants and there were no contextual cues for strong pitch accent, the low availability of these interpretations is expected from the viewpoint of a grammatical approach to implicatures. More research is needed on this issue to specify the circumstances under which local particularized conversational implicatures can occur at all. The results presented suggest that obligatorily inserting additives might be a good indicator.

Theories working with *Maximize Presupposition* would have to explain why competition with the stronger version with the additive is not activated and the resulting anti-presupposition did not arise, since otherwise the sentence without "too" should have been perceived as contradictory to the previous discourse more often. Of course making *Maximize Presupposition* sensitive to discourse is not impossible. However, there seems to be a clear contrast to the anti-presupposition resulting from using the indefinite. This inference, sometimes referred to as an anti-uniqueness inference (Heim, 1991), seems to arise as a default and seems to be insensitive to DE-operators and the broader discourse, see the (obligatory) oddness of (30) (cf. Bade, 2016).

(30) A man entered the bar. # If a man is thirsty, he will order a beer.

The results thus speak in favor of an analyses which distinguishes these cases from one another and postulates two groups of presupposition triggers when it comes to obligatory insertion: one, including additives, is inserted to avoid an implicature. The other, involving definites, follows from *Maximize Presupposition* (Bade, 2016; Bade and Tiemann, 2016).

The results further show that insertion of "auch" decreases acceptability of conditionals when its presupposition is fulfilled in the context. As predicted by *Obligatory Implicatures* the trigger is not obligatory per se but must be inserted only if an exhaustivity implicature must be blocked. The results suggest that the interpretation without any exhaustivity operators is the most acceptable one (M = 4,25). Its acceptability is not significantly affected by the presence of the trigger. However, it is significantly more available with the presence of the additive (35% versus 44%). That is, the additive must be considered optional for the acceptability of sentences with this interpretation (#EXH).

For the rare cases in which the conditional was interpreted as contradicting the context, the additive did not affect the overall low acceptability either (M=3,15). What is puzzling is that the availability of these interpretations seemed to increase with the presence of the additive. One possible explanation is that the presence of an overt focus sensitive particle increased the pressure to put focus on the noun it associated with. This focus was then understood as contrastive to the previous discourse. However, that means that, to make the presupposition of "auch" true, participants must have accommodated another antecedent/true proposition in the discourse. More research is needed to understand why this option was available at all since additives are usually considered very hard to accommodate (Heim, 1992). Since the interpretation was rarely chosen and only by few participants individual differences might be at play here as well.

The interpretation which was most often chosen (55% on average) and received the overall lowest acceptability is one which is in line with an analysis where an exhaustivity operator is present in the structure, but above the "if"-clause, see (31).

(31) EXH If Peter came (too), there were discussions.
'Only if Peter came (too), there were discussions.'
a. $\forall$w $\in$ {w': w' is compatible with the evidence available in the utterance situation in $w_{@}$ } & Peter came in w $\rightarrow$ there were discussions in w

This interpretation is available with and without the additive. However, its availability significantly decreased with the presence of "too" (62,3% versus 47,4%) and so did its acceptability (M=3 versus M=2,6). This interpretation must thus be considered the crucial one for explaining the overall decrease in acceptability with the presence of the additive. Whereas additional stipulations have to be made to explain this using *Maximize Presupposition* the results can straightforwardly be explained using *Obligatory Implicatures*. The relevant QUD (Question Under Discussion, Roberts (1996)) at play for this reading seems to be the one in (32), providing the set of alternatives in (32a). EXH above "if" excludes one alternative, see (32b).

(32) If who came, there were discussions?
a. {If Peter came,...; If Mary came...; If Peter and Mary came ... }
b. $\neg\forall$w $\in$ {w': w' is compatible with the evidence available in the utterance situation in $w_{@}$ } & Mary came in w $\rightarrow$ there were discussion in w

What "too" marks in this case is not that the question in (32) has been previously answered but rather that the "local" question "Who came?" has already been answered (by the previously asserted "Mary came"). As was mentioned before, exhaustifying (31) with respect to the QUD in (32) will not be contradictory to the fact that Mary came. As a result, the additive is not considered obligatory. The fact that it is even perceived as disturbing in this case can be explained by assuming that making reference to an already answered QUD which is not relevant to the current QUD anymore is a dispreferred pragmatic move.

The answer to the question whether additives are obligatory in antecedents of conditionals thus seems to depend on what interpretation is chosen for the conditional. If the context allows for an interpretation without any exhaustivity operators, the additive is optional. It does not change acceptability but can make this interpretation clearer. With an interpretation where an exhaustivity operator is inserted high, above the "if"-clause, the insertion of the additive is perceived as the dispreferred option. The results further supports *Obligatory Implicatures* and the view that additive particles can function as a window into local exhaustivity implicatures.

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Two indefinite pronouns in Catalan Sign Language (LSC)[1]

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Abstract. This paper analyses two pronouns in Catalan Sign Language (LSC) that refer to unidentified human referents: WHO^SOME $_{\text{up}}$ and ONE $_{\text{up}}$. We first show that in contexts that discriminate between indefinite pronouns and existential readings of human impersonal pronouns, both pronouns pattern with indefinite pronouns. We then examine the semantic properties of the two pronouns. WHO^SOME $_{\text{up}}$ and ONE $_{\text{up}}$ contrast with respect to their number, compatibility with collective predicates, scope with respect to event iteration and domain restriction requirements. In terms of specificity, both pronouns are epistemically non-specific, but ONE $_{\text{up}}$ is interpreted as scopally and partitively specific while WHO^SOME $_{\text{up}}$ is neutral with respect to scopal and partitive specificity.

Keywords: Catalan Sign Language (LSC), semantics, indefinite pronouns, specificity distinctions

1. Introduction

This paper examines two expressions that refer to unidentified human referents in Catalan Sign Language (LSC, *llengua de signes catalana*): the pronouns WHO^SOME $_{\text{up}}$ and ONE $_{\text{up}}$.[2]

(1) **ONE $_{\text{up}}$** HOUSE ENTER STEAL.
'Someone broke into the house.'

(2) **WHO^SOME $_{\text{up}}$** GO INDIA VACCINATE MUST.
'When one goes to India one must get vaccinated/
When someone goes to India he must get vaccinated.'

The goals of this paper are two-fold. First, we will show that these expressions correspond to indefinite pronouns comparable to (3), rather than existential uses of impersonal pronouns as exemplified by German *man* or French *on* in (4).

[1]The research reported in this paper is part of the Franco-German ANR-DFG project *Towards a typology of human impersonal pronouns* (ANR-11-FRAL-0011, 2012–15). The work of G. Barberà was partly supported by the project GramRefLSC, Ministerio de Economía y Competitividad, FFI2015-68594-P. For their useful comments and interesting discussions on previous versions of this work, we would like to thank the audiences at the *Workshop on the Semantic Contribution of Det and Num* (UAB, May 2016), *Formal and Experimental Advances in Sign Language Theory* (FEAST) (Venice, September 2016), *Sinn und Bedeutung 21* (Edinburgh, September 2016), and *New Ideas in Semantics and Modelling* (Paris, September 2016). We are grateful to Delfina Aliaga and Santiago Frigola for the eliciation sessions and for the discussions on LSC. Thank you to Rob Truswell and the editors for their careful comments and suggestions on this paper. All remaining mistakes are our responsibility.

[2]This article follows the usual glossing conventions in the sign language literature. Manual signs are represented by the capitalized word corresponding to the translation of the sign. The abbreviations used in the glosses are the following (# is a placeholder for the loci in signing space corresponding to 1st, 2nd and 3rd person referents): IX# (index pointing sign); #-VERB-# (verb agreeing with subject and object). Sub-indices mark localizations in signing space: *lo* (low), *up* (up); lower indexed letters (*a, b*) mark lateral loci and coreference relations. Reduplication of signs is indicated by +++.

(3) **Someone** stole my bike.

(4) **On** a volé mon vélo. (Fr)
Man hat mein Fahrrad gestohlen. (Ge)
ON/MAN has (stolen) my bike (stolen)
'They stole my bike.'

Secondly, we examine the profile of the two pronouns regarding epistemic, scopal and partitive specificity (see Farkas, 2002; von Heusinger, 2002). We will show that both pronouns are epistemically non-specific. WHO^SOME$_{\text{up}}$ is neutral with respect to scopal and partitive specificity, while ONE$_{\text{up}}$ is interpreted as scopally and partitively specific.

We proceed as follows. Section 2 provides some background on the referential use of space in sign languages in general and in LSC more specifically. In Section 3 we discuss the morphological composition of WHO^SOME$_{\text{up}}$ and ONE$_{\text{up}}$. In Section 4 we examine the two pronouns in contexts that are characteristic for human impersonal pronouns and we show that both expressions pattern with indefinite pronouns, not with existential readings of impersonal pronouns. In Section 5 we present an array of semantic contrasts between the two pronouns. Section 6 concludes.

2. Background: The use of space in sign languages

In sign languages, space is used for grammatical purposes (see Perniss, 2012, for a detailed overview). In Western sign languages, signing space is considered to be constrained to the space in front of the signer's torso. The signing space can be divided into the horizontal plane and the frontal plane. The horizontal plane is perpendicular to the body of the signer and is the default plane where the majority of signs are localized (Figure 1). The frontal plane runs parallel to the body of the signer from the waist up (Figure 2).

Figure 1: Sign localized on the horizontal plane

Figure 2: Sign localized high on the frontal plane

The figures above illustrate signs associated with a lateral area in the horizontal plane (Figure 1) and in the high part of the frontal plane (Figure 2). The spatial area associated with a Noun Phrase (NP) in sign language is called R-LOCUS (Klima and Bellugi, 1979). Canonically, NPs are associated with a locus on the horizontal plane of signing space, for example by a pointing index sign glossed IX3 (as in Figure 3) or by signing the lexical sign in the area of the locus (as in Figure 4 below).

Figure 3: Sign IX3$_a$ pointing to R-locus *a*

In a sentence like (5) below, the two arguments are associated with two distinctive R-loci, indicated in the glosses by the subscripts *a* and *b* and shown in the pictures in Figure 4. The R-loci play a role for agreement and for anaphoric reference. As illustrated in Figure 5, the agreeing verb GIVE moves from the R-locus of the subject MARTÍ to the R-locus of the object JOANA. As shown by the continuation (6), R-loci may be used in coreferential contexts to refer to a previously introduced argument, for example by using a pronominal index sign IX3$_a$ as in Figure 3.

(5) MARTÍa IX3a JOANAb IX3b BOOK 3a-GIVE-3b.
‘Martí gave Joana a book.’

Figure 4: Sign MARTÍ at R-locus *a* Sign JOANA at R-locus *b*

Figure 5: Verb GIVE articulated from R-locus *a* to R-locus *b*

(6) **IX3a** BOOK INTEREST.
'He (Martí) found the book interesting.'

In example (5) the R-loci for the NPs are on the horizontal plane in front of the torso, as illustrated by Figure 4. It has been shown that the height of localization in the frontal plane is also relevant for the expression of reference. In American Sign Language (ASL) high R-loci trigger an indefinite interpretation (Bahan, 1996; MacLaughlin, 1997). In LSC, the frontal plane is used to express specificity distinctions (Barberà, 2012): NPs localized at a low R-locus are interpreted as epistemically specific (they are identifiable by the signer and belong to a restricted set), whereas NPs localized at a high R-locus are interpreted as epistemically non-specific (they are unidentifiable by the signer and do not belong to a restricted set).

The following examples provide a minimal pair for the interpretation of high vs. low R-locus for an NP in LSC.[3] In (7a) the determiner SOME is localized at a low R-locus (indicated in the glosses with *lo*, Figure 6) and corresponds to a reading where the signer is talking about a specific group of students, which he can identify. In (7b), in contrast, the determiner SOME is localized at a high R-locus (indicated in the glosses with *up*, Figure 7) and a non-specific reading arises: the signer cannot identify the set of students.

(7) a. STUDENT SOME$_{lo}$ DEMONSTRATION GO. (LSC)
'Some students (that I can identify) went to the demonstration.'
b. STUDENT SOME$_{up}$ DEMONSTRATION GO.
'Some students (that I cannot identify) went to the demonstration.'

Figure 6: Sign SOME at a low R-locus

Figure 7: Sign SOME at a high R-locus

The two pronouns analysed in this paper are articulated in a high R-locus and trigger an epistemically non-specific interpretation, resembling the behaviour of NPs in this respect. However, in some contexts, pronominal elements in LSC articulated in high R-loci may have a scopally and partitively specific interpretation, unlike lexical NPs (see Section 5 below).

[3] In sign languages, signing space may be also used topographically. In topographical uses of space the spatial location of the sign provides information about the actual locations of entities, for example when referring to a book located on a high shelf (see Perniss, 2012, for discussion of different uses of signing space). In this article we leave the topographical use aside.

3. Morphological properties of the two pronouns

The pronoun WHOˆSOME$_{up}$ is the concatenation of the sign for the interrogative pronoun WHO with the sign for the determiner SOME. The manual component of both uses of WHO is an arc-shaped movement of the wrist with the thumb pointing upwards, localized on the chin of the signer and with final contact.

The interrogative use of WHO (8) and the WHO forming part of the indefinite pronoun (9) differ in their non-manual components. While the interrogative particle co-occurs with furrowed eyebrows (Figure 8), the indefinite pronoun co-occurs with particular non-manuals that include sucking the cheeks in and pulling the mouth ends down, sometimes combined with a shrug (Figure 9).

(8) COME **WHO**?
'Who came?'

(9) IX3 **WHO**ˆSOME$_{up}$ SEE.
'She saw someone.'

Figure 8: The sign for the interrogative WHO

Figure 9: Sign for the pronoun WHOˆSOME$_{up}$

The indefinite pronoun ONE$_{up}$ is signed in a high locus (see Figure 10) with the handshape of the numeral ONE (see Figure 11). The non-manuals for the indefinite pronoun ONE$_{up}$ resemble those for the indefinite pronoun WHOˆSOME$_{up}$ (Figure 9): they also consist in sucking the cheeks in and pulling the mouth ends down (Figure 10).

(10) **ONE** $_{\mathbf{up}}$ HOUSE ENTER STEAL.
'Someone broke into the house.' (= (1))

(11) **ONE** GIRL HOUSE ENTER.
'A/one girl broke into the house.'

Figure 10: The pronoun ONE $_{\text{up}}$ at a high locus, ex. (10)

Figure 11: The numeral ONE at a low locus, ex. (11)

Both pronouns are articulated in a high location of signing space (as indicated by the subscript *up* in the glosses), rather than in the default lower area. Both receive an epistemically non-specific interpretation, as is generally the case for elements associated with R-loci in the higher plane in LSC (see Barberà, 2012, and discussion of the example (7) above).

4. Indefinite or Impersonal Pronouns?

In LSC non-specific human pronouns are a common strategy to encode an unspecified human referent (Barberà and Quer, 2013). Reference to an unspecified human referent is also part of the semantic domain of dedicated human impersonal pronouns that allow existential readings such as German *man* or French *on*.

We have shown above that morphologically WHOˆSOME $_{\text{up}}$ looks like a wh-indefinite. The pronoun ONE $_{\text{up}}$, however, could potentially be an impersonal pronoun derived from the numeral *one*, as English *one* or Spanish *uno*.

To establish that WHOˆSOME $_{\text{up}}$ and ONE $_{\text{up}}$ are indeed indefinite pronouns, we examined their behaviour in contexts that distinguish indefinites from existential uses of impersonal pronouns cross-linguistically (see Cabredo Hofherr, 2008, and references cited there). Indefinite pronouns (i) are incompatible with a generalizing reading in simplex sentences, (ii) are incompatible with corporate readings, (iii) trigger disjoint reference when the pronoun is repeated in anaphoric chains, and (iv) have narrow and wide scope interpretations with respect to adverbs like *twice*. Impersonal pronouns, in contrast, (i) are compatible with a generalizing reading, (ii) are compatible with corporate readings, (iii) typically allow joint and disjoint reference when the pronoun is repeated in anaphoric chains, and (iv) have a narrowest scope interpretation in their existential uses. We consider each of the four contexts in turn.

4.1. Generalizing vs. episodic readings

Episodic contexts are contexts in which an individual or an event is anchored to a particular spatio-temporal context (*Yesterday John had breakfast at 10am*). In contrast, in generalizing contexts either the individuals or the events are not anchored to a spatio-temporal context and express either recurring properties of an individual (*John has breakfast at 7am*) or general properties not tied to particular individuals (*Pandas are big/eat bamboo*).

The French pronoun *on* has generalizing and episodic readings. The generalizing reading of *on* is exemplified in (12a). This reading is comparable to the English *people* or to non-anaphoric *they*, as in the translation of (12a). As (12b) shows, indefinite pronouns like *someone* do not allow generalizing readings over people in general.

(12) a. Au Mexique, **on** mange des grillons. (Fr)
in Mexico ON eats indef.pl grasshoppers
'In Mexico, they / people eat grasshoppers.'
(generalizing over people associated with Mexico)
b. In Mexico, **someone** eats/ate grasshoppers.
(not generalizing over people associated with Mexico, ≠ (12a))

The two LSC pronouns typically appear in episodic contexts (13). When inserted in generalizing contexts, the pronouns are interpreted on a par with (12b): (14) is understood as a habitual reading for an unspecified individual, but not as a generalization over individuals in Lleida in general.

(13) a. YESTERDAY **ONE** $_{\mathbf{up}}$ BIKE STEAL-3 $_{\text{up}}$.
b. YESTERDAY **WHOˆSOME** $_{\mathbf{up}}$ BIKE STEAL-3 $_{\text{up}}$.
'Yesterday someone stole a/the bike.'

(14) a. LLEIDA **ONE** $_{\mathbf{up}}$ SNAIL EAT.
b. LLEIDA **WHOˆSOME** $_{\mathbf{up}}$ SNAIL EAT.
'In Lleida, there is someone who eats snails.'
(not generalizing over people associated with Lleida)

In locative universal contexts as in (15) the null subject triggers a generic reading in LSC, meaning something paraphrasable with *people associated with location X in general*. When WHOˆSOME $_{\text{up}}$ is used in this context the episodic reading arises (16). The insertion of ONE $_{\text{up}}$ in the context triggers either an episodic reading (17a) or a habitual reading of the predicate, with an existential interpretation of the individual (17b).

(15) CHINA AREA EAT CAT. (null subject)
'In China they eat cats.'

(16) CHINA AREA **WHOˆSOME** $_{\mathbf{up}}$ EAT CAT.
'In China someone ate a cat/some cats.'

(17) CHINA AREA **ONE $_{\mathbf{up}}$** EAT CAT.
a. 'In China someone ate a cat/cats.'
b. 'In China, there is someone who eats cats.'

4.2. Corporate readings: predicates with designated subjects

Corporate readings arise with predicates that have a designated subject such as *deliver the mail, raise taxes* (Kärde, 1943; Pesetsky, 1995). In French, the corporate reading is compatible with an existential reading of the impersonal human pronoun *on*. The impersonal *on/they* in (18) is interpreted as referring to the people charged with raising taxes. Indefinite pronouns like *quelqu'un / someone*, in contrast, do not receive an interpretation corresponding to the group prototypically associated with the predicate in (19).

(18) **On** a augmenté les impôts.
'ON raised the taxes.' > '**They** raised taxes.'
(corporate reading: the people in charge of raising taxes)

(19) **Quelqu'un** a augmenté les impôts.
'**Someone** raised the taxes.'
(no corporate reading: agent not part of the designated subject of the predicate).

In LSC, neither WHO^SOME $_{\text{up}}$ nor ONE $_{\text{up}}$ trigger the corporate interpretation in the parallel examples. Like (19), the examples in (20) are interpreted as saying that there was an unknown individual who raised the taxes but the examples do not imply that this individual belongs to a designated group of people in charge of raising taxes.

(20) a. **WHO^SOME $_{\mathbf{up}}$** RAISE TAXES.
b. **ONE $_{\mathbf{up}}$** RAISE TAXES.
'Someone raised the taxes.' ($\sim$ (19))

4.3. Scope with respect to adverbials

Existential uses of impersonal pronouns, like French *on* and German *man*, have obligatory narrow scope with respect to frequency adverbs like *twice* or *always* (Zifonun, 2000 for German; Cabredo Hofherr, 2008 for French).

(21) On a volé mon vélo deux fois. (Fr)
ON has stolen my bike two times
'ON stole my bike twice.' (2 times >someone)

Neither of the two LSC pronouns takes obligatory narrow scope. WHO^SOME $_{\text{up}}$ allows wide and narrow scope readings with respect to the adverb, with wide scope for the pronoun preferred in examples like (22a). ONE $_{\text{up}}$ differs from WHO^SOME $_{\text{up}}$ with respect to scope: the use of ONE $_{\text{up}}$ only allows a wide scope reading (23).

(22) WHOˆSOME $_{\text{up}}$ IX1 BIKE 1-STEAL-3 $_{\text{up}}$++ TWO TIMES.
'Someone stole my bike two times. / Two times, someone stole my bike.'
a. someone > 2 times (preferred)
b. 2 times > someone

(23) ONE $_{\text{up}}$ BICYCLE 1-STEAL-3 $_{\text{up}}$++ TWO TIMES.
'Someone stole my bicycle two times.' (someone > 2 times)

However, the use of signing space introduces a complicating factor: The localization of the R-loci in signing space can disambiguate in favour of a reading with co-varying subjects for the different events. In LSC the establishment of two different R-loci for the subject explicitly marks distribution over the subject, resulting in a reading where the indefinite subject co-varies with the stealing event (narrow scope reading). In example (22), the iterated movement of the verb STEAL is twice to an unspecified R-locus, marked ++ in the gloss. In example (24) below, in contrast, the agreeing verb STEAL is inflected with two distinct lateral R-loci (R-locus *a* and R-locus *b*) and this yields an interpretation according to which on two occasions my bike was stolen, by two different individuals.

(24) WHOˆSOME $_{\text{up}}$ IX1 POSS BIKE **1-STEAL-3** $_{\textbf{up.a}}$ **1-STEAL-3** $_{\textbf{up.b}}$ TWO TIMES.
'They stole my bike two times.' (2 times > someone)

The availability of this explicitly distributing inflection for the verb may contribute to the preference for example (22) to be interpreted as not distributed.

We further tested the effect of adverb placement on interpretation. In order to avoid explicit distribution over different R-loci, we used the adverb ALWAYS in these examples. With the pronoun ONE $_{\text{up}}$, the interpretation of the subject is a constant individual ($\sim$ specific indefinite) independently of the position of the adverb ALWAYS (see (25a)/(26a)/(27a)). For WHOˆSOME $_{\text{up}}$ the position of the adverb ALWAYS makes a difference to interpretation. With an initial or final position of ALWAYS, the pronoun WHOˆSOME $_{\text{up}}$ is interpreted as (potentially) co-varying with the iterated events (25b)/(26b). A reading as a constant individual is forced when ALWAYS appears between WHOˆSOME $_{\text{up}}$ and the verb as in (27b).

We analyse the contrast with respect to WHOˆSOME $_{\text{up}}$ as indicating that WHOˆSOME $_{\text{up}}$ is interpreted inside the VP by default and only takes wide scope if it is overtly separated from the VP by the adverb ALWAYS.

(25) a. IX NEIGHBOURHOOD ONE $_{\text{up}}$ BIKE STEAL-3 $_{\text{up}}$ **ALWAYS**.
'In this neighbourhood there is someone who always steals bikes.'
(constant agent of the stealing events)
b. IX NEIGHBOURHOOD WHOˆSOME $_{\text{up}}$ BIKE STEAL-3 $_{\text{up}}$ **ALWAYS**.
'In this neighbourhood they always steal bikes.'
(agent of stealing events need not be identical, can co-vary with the events)

(26) a. **ALWAYS** IX NEIGHBOURHOOD ONE $_{\text{up}}$ BIKE STEAL-3 $_{\text{up}}$.
'In this neighbourhood there is someone who always steals bikes.'
(constant agent of the stealing events)
b. **ALWAYS** IX NEIGHBOURHOOD WHO^SOME $_{\text{up}}$ BIKE STEAL-3 $_{\text{up}}$.
'In this neighbourhood they always steal bikes.'
(agent of stealing events need not be identical, can co-vary with the events)

(27) a. IX NEIGHBOURHOOD ONE $_{\text{up}}$ **ALWAYS** BIKE STEAL-3 $_{\text{up}}$.
b. IX NEIGHBOURHOOD WHO^SOME $_{\text{up}}$ **ALWAYS** BIKE STEAL-3 $_{\text{up}}$.
'In this neighbourhood there is someone who always steals bikes.'

The data show that neither WHO^SOME $_{\text{up}}$ nor ONE $_{\text{up}}$ has the scope behaviour with respect to adverbs observed for existential readings of impersonal pronouns. We will come back to this contrast in scope behaviour between the two pronouns in Section 5 below.

4.4. Anaphora

In coreferential chains, impersonal pronouns (such as English *man*, French *on*, German *man*) allow co-referent interpretation of repeated pronouns as in (28), while indefinite pronouns do not (29).

(28) a. When **one** $_{i}$ goes to hospital, **one** $_{i}$ / he $_{*i/k}$ always fears the worst.
b. **One** $_{i}$ goes to hospital, and **one** $_{i}$ / he $_{*i/k}$ worries.

(29) a. When **someone** $_{i}$ goes to hospital, **someone** $_{*i/j}$ / he $_{i/*k}$ always fears the worst.
b. **Someone** $_{i}$ goes to hospital, and **someone** $_{*i/k}$ / he $_{i/k}$ worries.

With respect to this diagnostic, the two LSC pronouns again pattern with indefinite pronouns: the repetition of ONE $_{\text{up}}$ and WHO^SOME $_{\text{up}}$ triggers disjoint interpretation in (30)/(31). In LSC the equivalent of *when*-clauses is marked by the sign MOMENT as in example (30). Without MOMENT, the example corresponds to a paratactic coordination of two main clauses.

(30) **ONE $_{\text{up}}$** MOMENT HOSPITAL GO, **ONE $_{\text{up}}$** ALWAYS THINK RESULT WORST.
'When one $_{k}$ is admitted to the hospital, one $_{j}$ always fears the worst results.'
(= different people in hospital and worrying)

(31) **WHO^SOME $_{\text{up}}$** HOSPITAL GO, **WHO^SOME $_{\text{up}}$** ALWAYS THINK RESULT WORST.
'Someone $_{i}$ is admitted to the hospital; and someone $_{k}$ always fears the worst results.'
(= different people in hospital and worrying)

4.5. Summary

The diagnostics examined here show that neither WHOˆSOME$_{\text{up}}$ nor ONE$_{\text{up}}$ behave like episodic readings of impersonal human pronouns available for French *on* or German *man*.

Furthermore, there is evidence that WHOˆSOME$_{\text{up}}$ is not a relative pronoun introducing free relatives either. In LSC, relative clauses are marked with squinted eyes and, optionally, with the particle MATEIX (Mosella, 2012). The examples with WHOˆSOME$_{\text{up}}$ do not show either of these markings. The comparison of WHOˆSOME$_{\text{up}}$ with free relatives with a wh-pronoun as in (33) shows that the free relative is articulated with brow-raise with scope over the relative clause.

(32) WHOˆSOME$_{\text{up}}$ EXAM DONE LEAVE CAN.
‘When someone finishes the exam he can leave.

(33) [EXAM DONE WHO]$_{\text{brow raise}}$ LEAVE CAN.
‘Whoever has finished the exam may leave.’

We therefore conclude that both WHOˆSOME$_{\text{up}}$ and ONE$_{\text{up}}$ are indefinite pronouns in LSC that pattern with pronouns like *someone* in English. As we have seen in Section 4.3 above, however, the two indefinite pronouns differ in their interpretation with respect to frequency adverbs. In the next section we examine the semantic contrasts between the two pronouns in more detail.

5. Contrasts between WHOˆSOME$_{\text{up}}$ and ONE$_{\text{up}}$

In what follows, we show that WHOˆSOME$_{\text{up}}$ and ONE$_{\text{up}}$ differ with respect to a number of semantic properties: number specification, compatibility with collective predicates, co-variation of the referent with event pluralities and a requirement for domain restriction for the referent.

5.1. Plural vs. singular interpretation

WHOˆSOME$_{\text{up}}$ and ONE$_{\text{up}}$ differ with respect to their number specification. When WHOˆSOME$_{\text{up}}$ is used, the subject need not be singular (34a). With ONE$_{\text{up}}$ the subject has to be singular (34b).

(34) a. CHINA AREA **WHOˆSOME$_{\text{up}}$** EAT CAT.
In China someone/some people ate a cat/cats.’
(can be more than one person)
b. CHINA AREA **ONE$_{\text{up}}$** EAT CAT.
‘In China there is someone who eats cats.’
(one person only)

The contrast between the pronouns with respect to number interpretation is further confirmed in contexts in which the plurality of the unknown agent is explicitly denied. In the context we tested, an office has been broken into and after the event, the footprints belonging to a single person were found outside the office. The singular interpretation of ONE$_{up}$ coincides with the information about the number of the unknown agent from the context, and our informant added a confirmation headnod corresponding to an expression like *as expected* to the example in (35). In contrast, as WHO^SOME$_{up}$ is interpreted as 'more than one' by default, a context in which the footprints belong to the same person cancels the implicature that there is more than one agent of the event, leading to an expression of surprise by the informant (*How weird!?*) in (36).

(35) YESTERDAY HERE OFFICE **ONE$_{up}$** c-STEAL-3$_{up}$. AFTERWARDS CHECK FOOTPRINT $\overline{\text{UNIQUE SINGLE SAME IX3}_{\text{up}}}^{\text{headnod}}$
'Yesterday someone broke into the office. We checked the footprints afterwards and they belong to the same person, as expected.'

(36) YESTERDAY HERE OFFICE **WHO^SOME$_{up}$** c-STEAL-3$_{up}$. AFTERWARDS CHECK FOOTPRINT UNIQUE SINGLE SAME IX3$_{up}$. WEIRD.
'Yesterday some people broke into the office. We checked the footprints afterwards and they belong to the same person. How weird!?'

5.2. Collective and distributive readings

The analysis proposed of between WHO^SOME$_{up}$ as preferentially plural and ONE$_{up}$ as singular is further confirmed by the fact that WHO^SOME$_{up}$ is compatible with collective predicates (37), while ONE$_{up}$ is not (38).

(37) WAR CITY **WHO^SOME$_{up}$** SURROUND.
'They surrounded the city during the war.'

(38) *WAR CITY **ONE$_{up}$** SURROUND.

ONE$_{up}$ has a plural distributive form, consisting of a reduplication of the pronoun, which is grammatical with collective and distributive predicates. When this reduplicated form of the pronoun is used, reduplication of the verb is also obligatory; otherwise the sentence is ungrammatical. The reduplicated verb further triggers a distributive reading of the object.

(39) WAR CITY **ONE$_{up}$+++** SURROUND+++.
'They each surrounded a different city during the war.'

(40) NEIGHBOURHOOD **ONE$_{up}$+++** BIKE STEAL-3$_{up}$+++.
'In this neighbourhood, there is a number of (unidentified) people that each stole a bike/bikes.'

However, an exception is found with body-anchored verbs (like EAT), that do not admit reduplication. Because of this phonological restriction, the verb is not reduplicated when combined with the plural distributive form of ONE $_{\text{up}}$ but the sentence is still grammatical and we get the distributive reading.

(41) CAKE **ONE $_{\text{up}}$+++** EAT.
'Some people had a piece of cake each.'

5.3. Co-variation with the event

As we have already seen in Section 4.3 above, the two pronouns differ in their scoping properties with respect to adverbs. WHOˆSOME $_{\text{up}}$ triggers undetermined reference of subject and allows subjects to co-vary with the events.

In contrast, ONE $_{\text{up}}$ does not co-vary with respect to the events, yielding a scopally specific interpretation. The referent of WHOˆSOME $_{\text{up}}$ can co-vary with quantification over the event (here with the adverb ALWAYS): a scenario with a plurality of stealing events with different subjects for each event is possible. In contrast, with the pronoun ONE $_{\text{up}}$ there is not co-variation of the subject with respect to the events. Therefore the iterated thefts are perpetrated by the same unknown person.

(42) a. BUILDING IX POSS OFFICE DANGER. ALWAYS **WHOˆSOME$_{\text{up}}$** STEAL-3$_{\text{up}}$ MONEY
'The building of my office is very dangerous. They always steal money.'

b. BUILDING IX DANGER. IX1 POSS OFFICE ALWAYS **ONE $_{\text{up}}$** STEAL-3 $_{\text{up}}$ MONEY
'The building (of my office) is very dangerous. There is someone who always steals money in/from my office.'

5.4. Domain restriction

A restricted domain is compatible with both pronouns. However, while ONE $_{\text{up}}$ strongly favours a reading in which there is a salient set that the referent belongs to, such a set is not required with WHOˆSOME $_{\text{up}}$.

In the examples (43a) and (44a) with WHOˆSOME $_{\text{up}}$, the unidentified human referent can but need not belong to a contextually salient set. With ONE $_{\text{up}}$, however, the referent is interpreted as belonging to a particular set, as shown in examples (43b) and (44b).

(43) a. BUILDING IX FIRE FIREMEN ARRIVED. **WHOˆSOME $_{\text{up}}$** CL:GO-UP-ROOF
'The building was on fire and the firemen arrived. One (fireman or normal person) went up to the roof.'

b. BUILDING IX FIRE FIREMEN ARRIVED. **ONE $_{\textbf{up}}$** CL:GO-UP-ROOF
‘The building was on fire and the firemen arrived. One (of the firemen) went up to the roof.’

(44) a. LIBRARY WOMAN PERSON RETIRE. **WHOˆSOME $_{\textbf{up}}$** SUBSTITUTE
‘The librarian is getting retired. Someone (from a non-restricted set) will substitute her.’
b. LIBRARY WOMAN PERSON RETIRE. **ONE $_{\textbf{up}}$** SUBSTITUTE
‘The librarian is getting retired. One (of her team) will substitute her.’

Further evidence that ONE $_{\text{up}}$ explicitly favours a reading with a salient set is provided by continuations with the sign DE (meaning ‘belong’). In this context a continuation with a typical group inferred is more felicitous (45a) than a continuation with unexpected information (45b).

(45) ONE $_{\text{up}}$ DEAN INFORM
‘Someone informed the dean.’
a. PERSON $_{\text{up}}$ DE FACULTY.
‘He is someone from the faculty.’
b. # PERSON $_{\text{up}}$ DE GYMNASIUM.
‘He is someone from the gym.’

5.5. Interpretation of object and telicity

We found some evidence that the two pronouns seemed to correlate with a difference in telicity. With a telic predicate like EAT, WHOˆSOME $_{\text{up}}$ triggers a specific interpretation of the object, an episodic context and the event is interpreted as punctual (perfective) (46a). With ONE $_{\text{up}}$ as a subject, the interpretation of the object was non-specific, with either habitual interpretation (imperfective) or an episodic interpretation that did not have a salient individual as an object (46b).

(46) a. **WHOˆSOME $_{\textbf{up}}$** CAT EAT.
‘Someone ate a/the cat.’
Informants added: IX SEE DISAPPEAR ‘I see it disappeared.’
(the (relevant) cat is no longer there)
b. **ONE $_{\textbf{up}}$** CAT EAT.
‘There is one who eats cats.’
Informants intuition: a/the salient cat has not disappeared

In future work we will explore the hypothesis that the effect of the pronoun on the object is indirect. According to our working hypothesis, WHOˆSOME $_{\text{up}}$ is not interpreted as a topic, and the interpretation of the object as specific is triggered by the fact that it is interpreted as the most plausible topic. ONE $_{\text{up}}$, on the other hand, corresponds to a constant, if unindentified, individual and as such can be interpreted as a topic itself, favouring an interpretation in which the object is semantically incorporated comparable to *eat cats*.

5.6. Summary

Using the specificity distinctions discussed by Farkas (2002); von Heusinger (2002), the properties discussed in this section can be summarized as follows.

Both WHOˆSOME $_{\text{up}}$ and ONE $_{\text{up}}$ are epistemically non-specific: the referent of the pronoun is unknown to the signer and to the addressee.

The two pronouns differ with respect to their scopal properties: WHOˆSOME $_{\text{up}}$ is preferentially interpreted as having a narrow scope reading and co-varies with iterated events, while ONE $_{\text{up}}$ is interpreted as having wide scope with respect to event iteration. ONE $_{\text{up}}$ is scopally specific while WHOˆSOME $_{\text{up}}$ allows both wide and narrow scope interpretations.

Finally, the two pronouns differ with respect to partitivity. WHOˆSOME $_{\text{up}}$ can, but need not, be part of a salient group while ONE $_{\text{up}}$ is interpreted as belonging to a contextually salient group: ONE $_{\text{up}}$ is partitively specific while WHOˆSOME $_{\text{up}}$ is compatible with partitive or non-partitive interpretations.

The following table summarizes the contrasts between the two indefinite pronouns:

Types of specificity	WHOˆSOME $_{\text{up}}$	ONE $_{\text{up}}$
Epistemic unknown to signer	+ (16)	+ (17)
Scopal wide scope with TWICE	+/-	+
wide scope (sentence final/initial ALWAYS)	– (25a) & (26a)	+ (25b) & (26b)
wide scope (pre-verbal ALWAYS)	+ (27a)	+ (27b)
scope over event plurality **(co-variation with events)**	+ (42a)	- (42b)
Partitive interpreted as part of a salient group	–	+ (45)
Other properties		
Cardinality	1 or more (34a)	singular (34b)
Telicity punctual event vs. habitual	+ (46a) punctual	- (46b) habitual

6. Conclusions

We have shown that the expressions WHO^SOME $_{\text{up}}$ and ONE $_{\text{up}}$ pattern with indefinite pronouns like *someone*, not with existential readings of impersonal human pronouns like *on* in French. Both pronouns are epistemically non-specific since the referent of the pronoun has to be unknown to the speaker. Future work has to establish how WHO^SOME $_{\text{up}}$ and ONE $_{\text{up}}$ fit into the typology of epistemic indefinites discussed in the recent literature (Aloni and Port, 2011; Alonso-Ovalle and Menéndez-Benito, 2013).

The data presented further show that the two pronouns differ with respect to a range of semantic properties. First, while WHO^SOME $_{\text{up}}$ is number neutral, ONE $_{\text{up}}$ is interpreted as referring to a singular referent. For reference to a multiplicity, the sign ONE $_{\text{up}}$ needs to be reduplicated yielding a form ONE $_{\text{up}}$+++ that forces a distributive reading. Secondly, WHO^SOME $_{\text{up}}$ is preferentially interpreted has having a narrow scope reading with respect to unbounded event iteration, i.e. a reading in which the agent co-varies with the event, while ONE $_{\text{up}}$ is interpreted as having wide scope. We found that WHO^SOME $_{\text{up}}$ only gets a wide scope reading if it is overtly separated from the VP by the adverb ALWAYS. With respect to a bounded adverb like TWICE, WHO^SOME $_{\text{up}}$ takes wide scope. Finally, WHO^SOME $_{\text{up}}$ need not have a partitive interpretation, while ONE $_{\text{up}}$ has a partitive interpretation as belonging to a salient set. These observations suggest that ONE $_{\text{up}}$ is a strong indefinite, whereas WHO^SOME $_{\text{up}}$ is a weak indefinite.

In future work we will explore the hypothesis that WHO^SOME $_{\text{up}}$ and ONE $_{\text{up}}$ contrast with respect to their information structure status. Unless it is moved out of the VP, WHO^SOME $_{\text{up}}$ does not function as a topic making it similar to the implicit agent of passives: a sentence containing it will be interpreted as thetic unless an alternative topic is available. We will explore the hypothesis that ONE $_{\text{up}}$ on the other hand is scopally specific and interpreted as part of a group that is contextually salient. If this hypothesis is correct, the contrast between the two pronouns would resemble the contrast in English between the following two examples:

(47) a. They repaired the lift.
b. There is someone who repaired the lift.

Finally, the data discussed here show that in LSC the role of high loci in signing space is different for pronouns and for lexical NPs, suggesting that the structured use of signing space can be modulated depending on the grammatical category of the NP. Lexical NPs associated with a high locus are associated with an epistemically and partitively non-specific interpretation. In contrast, the pronoun ONE $_{\text{up}}$ is partitively specific despite the fact that it is associated with a high locus.

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HAVE as a relation between individuals and properties[1]

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Abstract. This paper argues that the role of HAVE-predicates is to introduce relations into the discourse, one of whose arguments is the individual denoted by the sentence subject. This is the only token-level argument in the relation: the other is modeled as a nominalized property (Chierchia, 1984; Chierchia and Turner, 1988). A number of peculiarities of HAVE are argued to follow from this account, including its connection with existential predicates (McNally, 1992, 2009).

Keywords: have, possession, properties, kinds, nominalized functions.

1. Introduction

Ever since Keenan (1987), a significant share of the semantic literature on HAVE[2] has focused on the compositional challenges posed by relational nouns in object position of this verb, i.e. the phenomenon dubbed 'existential-HAVE'. The goal is to account for the putative contrast between (1a) and (1b):

(1) a. John has a/many/the/every/both car(s)
    b. John has a/many/#the/#every/#both sister(s)

From this perspective, what needs to be explained is: (i) why relational nouns trigger a definiteness effect, largely parallel to that found in the pivot of existential sentences, while sortal nouns do not; (ii) how the subject ends up saturating/being identified with the internal argument of the object; (iii) how to factor in the contribution of the determiner within the object; and (iv) what exactly HAVE contributes to the meaning of the whole.

Several analyses of existential-HAVE have been suggested, all of which account for (at least some of) the data but make HAVE –or a small subset of its uses– look like a very peculiar creature full of idiosyncrasies. One of the consequences of such views is that they cast no light on the persistent intuition in the literature on possession that there is a some connection between HAVE, existential predicates and copular sentences.

This paper presents a compositional account of HAVE as a predicate that introduces a 2-place relation into the discourse by linking it to one of its participants, the sentence subject. As a result of introducing a HAVE-sentence into a context, the individual that the subject is in a relation to is also introduced. This result is achieved in an indirect way: HAVE relates its subject not with a token-level entity, but with a description of an individual; this description is modeled as a nominalized property (Chierchia, 1984; Chierchia and Turner, 1988). The nature of the

[1]I would like to thank Louise McNally, Josep M. Fontana, Bert LeBruyn, Henriette de Swart, Kjell Johan Sæbø, Joost Zwarts, and the audience of Sinn und Bedeutung 21 for discussion, and to Obra Social la Caixa, MINECO (grants FFI2013-41301-P and FFI2016-76045-P) and AGAUR (grant 2014SGR698) for financial support.

[2]HAVE refers to an abstract, language-independent predicate of which English *have*, French *avoir* or Catalan *tenir* are concrete manifestations.

relation introduced into the discourse as a result of uttering an—affirmative—HAVE-sentence depends on the relationality of the noun heading the object-NP.[3]

The analysis builds on the account of English existentials in McNally (1992, 2009), which was designed to account for the similarities between existentials and some copular predicates. It thus intends to capture both the observation that existentials and HAVE-sentences share a number of traits and the fact that if a language has a HAVE-verb, it is going to be an obvious candidate for the role of existential predicate.

The paper is organized as follows: section 2 goes over some of the existing semantic accounts of existential-HAVE; section 3 presents a range of data that challenge the existing views in one way or another; in section 4 I introduce the view of relational nouns that I will assume; section 5 lays out the assumptions I make about the notion of nominalized property and its relation to kinds and tokens; section 6 is devoted to the formal analysis; section 7 concludes.

2. The received view(s)

Space precludes an exhaustive summary of the analyses that have been put forward for existential HAVE in the last decades. I will limit myself to reviewing the assumptions and main elements that some of the existing accounts are built on (see e.g. Myler (2014) and LeBruyn and Schoorlemmer (2016) for up-to-date introductions to possession and HAVE-verbs).

Partee (1999) is the first compositional account of the observation (made in Keenan (1987)) that HAVE takes a 2-place predicate as its object, the internal argument of which seems to be saturated by the sentence subject. She assigns the determiner a relational type, which results in an NP denoting an 'unsaturated generalized quantifier'. HAVE is assigned a denotation that takes this special type, contributes an 'exist' predicate à la Barwise and Cooper (1981) (which explains the definiteness restriction), and makes sure the subject falls into the right place—the internal argument of the relational noun.

Landman (2004) offers a different view that is reminiscent both of Milsark's (1974) account of the English existential predicate and of analyses relying on the notion of semantic incorporation (Van Geenhoven, 1998), whereby HAVE combines with relations and provides existential quantification of one of their arguments—thus explaining the definiteness effect. Bassaganyas-Bars (2015) applies a similar view both to existential-HAVE and to the existential predicate in Old Catalan, a language in which the two constructions differ only in the oblique marking of one of the arguments in the latter.

LeBruyn et al. (2016) is another analysis that relies on the notion of incorporation (formalized in Dynamic Montague Grammar). On their view, HAVE takes properties (with implicit arguments) and 'relationalizes' them. The range of interpretations available is contributed by the lexical item in the case of relational nouns, and by the noun's Qualia Structure (Pustejovsky, 1995) in the case of sortal nouns. This analysis provides an insight I will make use of: it suggests that there is no difference in type between relational and sortal nouns; the distinction

[3]For the purposes of this paper, I am not making use of the NP/DP distinction.

between them, however, is crucial for determining the relation the HAVE-sentence eventually expresses. This implies that there is no difference between the two types of nouns regarding the definiteness restriction, a point I will also argue for.

This family of accounts shares the assumption that the analysis of ‘John has a sister’ needs to get us to the denotation logically represented in (2):

(2) $\exists x.\textbf{sister}(\textbf{j})(x)$

In different ways, they all succeed. However, they encounter problems when the full range of determiners (indefinite and definite) that are possible in existential-HAVE contexts is considered, as we will see below. Two of them (Landman and LeBruyn et al.), in fact, are designed for cases where the determiner is *a*, but they leave unclear how to treat other determiners.

Sæbø (2009) tackles the problem from a different angle. His account scopes beyond existential-HAVE to cover all the uses of HAVE. He suggests that HAVE always embeds small clauses (the predicate of which can be overt or implicit) and turns them into predicates, and the lambda-abstracted variable (which can come from a relational noun, an anaphoric element or an implicit relation of possession) is co-indexed with the sentence subject. The role of HAVE is, as in the other analyses, to connect the subject with the material in object position, but the options for accomplishing this go well beyond the binding of the internal argument of the relational noun. As in Partee (1999), the definiteness effect is ultimately attributed to an ‘exist’ predicate associated with relational nouns. Myler (2014) proposes a related analysis in the Distributed Morphology framework.

Sæbø’s analysis is technically complex and requires some non-standard assumptions, but it is able to subsume practically all uses of HAVE under an appealing single account. However, it relies heavily on covert material to yield the right interpretation for HAVE-sentences. In addition, by providing HAVE with a very special sort of semantics, it does not capture any similarities between HAVE and existential and copular contexts in an obvious way.

Although there are important differences among these analyses, in the next section we will see that they all run into complications once we consider all the data we naturally find with HAVE and the kinds of interpretation for HAVE-sentences they give rise to.

3. Bringing more data into the picture

The literature on existential constructions has converged on the idea that the definiteness effect requires a more fine-grained explanation than a simple opposition between ‘strong’ and ‘weak’ NPs. Most literature on HAVE, however, still relies on this type of account. There are essentially two kinds of cases where we find HAVE embedding a relational noun with a definite or obligatorily quantificational determiner. The first is not problematic for any of the accounts above. The second, however, is harder to accommodate.

The first case comprises those examples where the DP is not discourse-new and saturation of the internal argument of the relational noun does not depend on the sentence subject. This class of cases requires heavy contextual support. An example of such a context is provided by LeBruyn et al. (2016: 58). While playing a card-game based on the Simpson family, a player could utter (3a) if she had the card corresponding to Abraham J. Simpson, or (3b) if she were holding Bart, Lisa and Maggie's cards in her hands.

(3) a. I have the grandfather.
    b. I have every child.

Following Abbott (1993), I will call these readings *contextualized*. They contrast with the normal interpretation of sentences with relational nouns, where the relation expressed by the noun holds between the subject and the object; these are the *non-contextualized* readings. Partee (1999) and LeBruyn et al. (2016) associate contextualized interpretations with another version of HAVE, that works like a regular transitive verb.

The more problematic set of cases are those with definite NPs that clearly correspond to a non-contextualized reading. In some of them we get a kind or amount reading, as these examples from the Corpus of Contemporary American English (Davies, 2008) illustrate:

(4) a. The guy looks good for his age and has the body of an athlete (COCA)
    b. Stafford has the arm and the intelligence to be a good NFL QB (COCA)
    c. Pigs have the intelligence of a three year old child (COCA)

These sentences express non-contextualized relations between a person/animal and their body, arm, or intelligence, not context-dependent ones. Similar cases have the object of HAVE extracted from a restrictive relative clause. A cursory corpus search suggests that the main verb in the restrictive clause tends to be intensional (5a), but examples with extensional verbs can also be found (5b):

(5) a. I'd like to tell ten-year old Sarwat that at last he has the friends he was looking for (COCA)
    b. At twenty you have the face nature gave you (COCA)

Finally, NPs with overt classifiers like 'kind' or 'type' get a non-contextualized interpretation with definite articles and even obligatorily quantificational determiners. In a context where three kinds of sisters are being discussed (e.g. nice sisters, indifferent sisters and bully sisters), (6a) is perfectly possible with a non-contextualized reading; in a context where we assume that sisters come in different, recognizable kinds, (6b) is perfectly felicitous as well.

(6) a. Mary has the three kinds of sisters.
    b. Mary has every kind of sister.

The picture that starts revealing itself looks similar to the one we get with existential constructions. Definite or obligatorily quantificational NPs which preserve a non-contextualized reading with relational nouns are parallel to those that preserve a non-contextualized reading in

English existentials (Lumsden, 1988; McNally, 1992; Abbott, 1993, 1997):

(7) a. There was every *(kind of) biologist at that conference.
b. John has been every *(kind of) biologist.

The analyses we have gone over in the previous section do not account in an obvious way for this pattern of data. One can however envisage ways to accommodate the definites, e.g. by invoking type-shifting mechanisms or some operation akin to Chierchia's Derived Kind Predication (Chierchia, 1998).[4] In contrast, the behavior of quantificational NPs if they quantify over kinds is harder to fit into any of the analyses.

Other data point to the fact that HAVE does not behave like a regular, extensional transitive verb that relates two token-level entities. One such case is the resistance of the object of HAVE to be pronominalized with *wh*-relative pronouns. This feature is also shared with existential constructions, and contrasts with a common transitive like 'date':

(8) a. I like some of the friends/qualities *which/that/∅ John has.
b. I talked to some of the people *which/that/∅ there are in this class.
c. I know some of the people which/that/∅ you've been dating.

More evidence comes from dialects of English which allow for *that*-less subject relative clauses. They are permitted in intensional contexts, some copular constructions, existentials and HAVE-sentences (examples from McNally (2009)):

(9) a. I have an idea might work.
b. There's a man here can't speak English.

Finally, there is the fact that the most natural interpretation of an anaphoric pronoun in the object position of HAVE is a kind-level one (Myler, 2014). In a context where someone expresses admiration for a car parked on the street (say it is a Porsche 911), *it* or *one* in (10a) can be interpreted as referring to the car in question, whereas in (10b) they refer naturally to the kind of car, not the specific car-token.

(10) a. Did you know Mary owns it/that's the one Mary owns?
b. Did you know Mary has it/that's the one Mary has?

Data of this kind involving the English existential construction led McNally (1992) to analyze the pivot not as a token-level individual, but a higher-level one—a nominalized property. The introduction of an actual individual into the discourse (satisfying the descriptive content of the property) results from an entailment of the use of a HAVE-sentence.

The behavior of HAVE-sentences illustrated in (8), (9) and (10) looks mysterious under any of the accounts reviewed in the previous section, which in all cases consider HAVE a relation

[4]Derived Kind Predication is type-shifting operation that applies to predicates of objects so that they can combine with kind-denoting NPs. See Chierchia (1998: 364) for details.

between token-level individuals. In contrast, it gets a natural account if we consider that the object of HAVE denotes precisely a nominalized property. *Wh*-relative pronouns can be argued to be restricted to token-level entities; *that*-less relative clauses seem to be possible when the antecedent of the omitted pronoun refers to a non-token-level entity, and the kind-level interpretation of the anaphora in the object of HAVE follows if kinds are understood as higher-order individuals as well (as most literature making use of both nominalized properties and kinds assumes—see e.g. Chierchia (1998) and McNally (2009)).

If we consider in addition that, as mentioned above, HAVE is one of the main sources of existential predicates cross-linguistically (Creissels, 2014), which is expected if the object of HAVE and the pivot in existential predicates are ontologically similar, an account that treats HAVE as a relation between a token-level individual and a nominalized property starts looking like a serious candidate for explaining what is it that makes HAVE look like such a strange, slithery creature. Before turning to the formal analysis, I will lay out the assumptions I will make about relational nouns and nominalized properties.

4. A non-transitive view of relational nouns

Most of the accounts of existential-HAVE reviewed above rest on the view of relational nouns which conceives of them as transitive nouns.[5] Making logical representations like (11) fit into the composition of HAVE-sentences is the thread that unifies this line of research.

(11) $[\![\text{mother}]\!] = \lambda x \lambda y.\mathbf{mother}(x)(y)$

This view of relational nouns is not, however, without problems. One of them is that it groups together classes like body-parts, kinship terms, parts and wholes and deverbal and deadjectival nominalizations (Barker, 1995), which on the one hand are treated in disparate ways in different languages, and on the other tend to behave differently with respect to tests within each individual language (Heine, 1997).

A second (related) problem is that tests that select for the class of relational nouns as a whole are scarce. The most used one is compatibility with *of*-PPs in possessive NPs in English. This test is not free of problems either, as the felicity of (12a) (from LeBruyn et al. 2016), and the existence of contrasts like the one in (12b) shows.[6] (See LeBruyn et al. (2016) and references therein for more issues on the conception of relational nouns as transitive nouns.)

(12) a. The blog of Doctor Watson
b. The hammer of Thor/#my uncle

[5] LeBruyn et al. (2016) treat them as being of type $\langle e,t \rangle$, but they ultimately rely on providing them with another argument to explain their interaction with HAVE.

[6] This particular example may point to a contrast between necessary and contingent relations, which some languages mark overtly (Heine, 1997). The relation between Thor and a hammer can be conceived as a necessary one; having a hammer is one of the features that defines Thor. In contrast, it does not define normal people's normal uncles. The fact that relational nouns normally sound felicitous in the *of*-PP construction could stem from the fact that they express necessary relations, but the class of necessary relations is bigger than the ones expressed by relational nouns. Whether this hypothesis is worth pursuing remains for future research.

Although these arguments against treating relational nouns as having argument structure are not absolutely conclusive, there might be room for an alternative treatment that avoids these problems, simplifies composition, and makes additional correct predictions. I will therefore treat relational nouns as one-place predicates with an associated meaning postulate whereby they entail the existence of another entity they are in a particular relation to:

(13) a. $[\![mother]\!] = \lambda x.\mathbf{mother}(x)$
b. $\forall x \forall w[\mathbf{mother}_w(x) \rightarrow \exists y[\mathbf{motherhood}_w(y)(x)]]$

(14) a. $[\![friend]\!] = \lambda x.\mathbf{friend}(x)$
b. $\forall x \forall w[\mathbf{friend}_w(x) \rightarrow \exists y[\mathbf{friendship}_w(y)(x)]]$

(15) a. $[\![top]\!] = \lambda x.\mathbf{top}(x)$
b. $\forall x \forall w[\mathbf{top}_w(x) \rightarrow \exists y[\mathbf{part\text{-}whole}_w(y)(x)]]$

On this view, relational nouns are relation-entailing predicates of individuals. Let us hypothesize that their use in discourse is governed by the condition in (16):

(16) The introduction of a token discourse referent for a relation-entailing individual x needs to be anchored to a discourse referent corresponding to the other argument in the relation they entail.

To see how this works, let us consider the following example, which illustrates how the relational noun 'girlfriend' can be used in discourse:

(17) After a woman found out via Facebook that a man who'd 'poked' her in real life had a long term girlfriend, she turned to digital manners advice givers Farhad Manjoo and Emily Yoffe of Slate to ask whether she should tell the girlfriend. (COCA)

The entity corresponding to the description 'girlfriend' is first introduced into this piece of discourse by a HAVE-sentence. The condition above is respected: the HAVE-sentence anchors it to the other entity in the relation. Once this is done, an entity satisfying the description has entered the discourse and can be referred to freely, as in the last sentence of (17).[7]

(17) illustrates that the most straightforward way English offers to introduce a relational noun into the discourse is a HAVE-sentence.[8] The relation between HAVE and relational nouns seems to be a symbiotic one. These (individual-denoting) nouns need a predicate to introduce them

[7]This view explains another putative test for relational nouns, viz. incompatibility with predicatively used genitives (Partee, 1997):

(i) a. That computer is John's
b. ??That girlfriend is John's

The infelicity of (ib) can be attributed to a violation of (16). Making the relational noun the sentence topic strongly implies that the individual it describes is already part of the discourse model. This entails that the entity it is in a relation to has also been introduced. The only possibility to interpret (ib) is to look for an alternative relation between this 'girlfriend' and John. Lacking any context, we cannot find one.

[8]Another possibility is the use of a possessive NP (either with *'s* or an *of*-PP), in which case the existence of the relation is presupposed and needs to be accommodated by the hearer.

into the discourse by linking them to an individual, to which they are in the relationship they entail. The job of HAVE, in turn, is precisely to introduce into the discourse relations linked to an individual—and eventually resulting in the addition of an individual describable with the relational noun into the discourse model. HAVE cannot supply a value for the relation, but the meaning postulate associated with the relational noun is there to contribute one.

The treatment of relational nouns presented here is parallel to the one for deverbal nouns in Grimm and McNally (2013), a class of nouns which is usually analyzed as relational (Barker, 1995: 60-62). Grimm and McNally treat them as one-place, relation-entailing nouns. They denote properties of events and are subject to a discourse condition very similar to (16): when they are introduced into the discourse, they need to be anchored to one of the participants they entail (see Grimm and McNally (2013) for details).

The account presented so far explains the relations conveyed by HAVE-sentences with discourse-new relational nouns. Turning to discourse-new sortal nouns, I will argue that they are used to convey non-ambiguous relations as well. Their value does not come from entailments of the noun, but from a combination of the semantics of the object and the subject, and world-knowledge. This is illustrated by the following sentences:

(18) a. My neighbor has many dogs
b. Have you visited John's pet shop? He has many dogs!
c. If you want to buy a dog, go to the dog pound first: they have many dogs

Sentence (18a), uttered in a context where no specific information about the neighbor in question is part of the conversational background, expresses the standard relation that holds between human beings and dogs, the one we could call a 'person-dog relation'. This relation, provided by world knowledge, entails things like having the dog at home, feeding it, walking it, petting it, etc. This contrasts with the relations between dogs and pet-shop owners (18b) and dog-pounds (18c), for which different sets of entailments hold.

The upshot of that is that, when we hear a HAVE sentence with a non-relational noun like *dog* in object position, in a certain context, and after we have identified what kind of entity the subject is, world knowledge gives us a default relation between the two entities; this is how the nature of the relation introduced by HAVE is determined with non-relational nouns.[9]

It follows from the present account (as it does from LeBruyn et al. 2016) that the contrast between (1a) and (2) is an illusory one, and that something much like the definiteness effect should also hold for sortal nouns. That is, the way the full interpretation of (19a) and (19b) is determined differs.

[9]This view thus goes against accounts that rely entirely on free 'pragmatic determination' to settle the actual relation holding between the subject of the sentence and a noun like 'dog'. In contrast, it could in principle be compatible with the most elaborate account of how the meaning of these sentences is determined (LeBruyn et al., 2016), although how to factor in the contribution of the subject in this account is not immediately obvious. It is also compatible with a 'co-composition' account along the lines of Spalek (2014). Further details concerning this aspect of the analysis must be left for future research.

(19) a. John has a/two/many beautiful car(s)
b. John has the/every/both beautiful car(s)

Tham (2006) defends this view. She argues that (19a) is an instance of 'presentational *have*', which requires the NP to be discourse-new; the definiteness effect is given a pragmatic explanation à la Abbott (1993). (19b), in contrast, is a special use where HAVE can take definite NPs, which is only possible when previous context supplies a relation between the two entities (Tham, 2006: 143). LeBruyn et al. (2016) reach a similar conclusion. Tham argues that there are languages (e.g. Mandarin Chinese) with a HAVE-verb that forbids definite objects. In the same vein, Heine (1997) points out that 'there exists a strong correlation between have-constructions and the presence of indefinite possessees, to the effect that, in many languages, have-constructions assume meanings other than possessive ones unless associated with indefinite possessees' (Heine, 1997: 35).

Therefore, there seems to be some evidence for an account that teases apart how we determine the meaning in (19a) and (19b), so that (19b) is grouped with (20) instead.

(20) John has the/every/both child(ren)

This sentence is possible in a context where a child (or some children) are already part of the discourse model. According to (16), this requires that the entity they are in a parent-child relation to has been introduced into the discourse as well. Therefore, the relation between John and the child(ren) in question that (20) refers to has to be determined in some other way. Tham and LeBruyn et al. argue that in at least some of these cases it is up to discourse context to provide a salient interpretation. For instance, (20) could be uttered in a context where a group of paparazzi are following a celebrity family and they are assigned family members as specific targets. Partee (1999) and Sæbø (2009) seem to rely on vague interpretations of 'possessive' relations such as control, part-whole, etc. The issue cannot be settled here—although see Tham (2006) for some examples that do not imply 'control' in any intuitive way.

Equipped with these assumptions about relational and sortal nouns and the way they interact with HAVE, we can now tackle the next piece of the analysis: nominalized properties.

5. Nominalized properties, kinds and tokens

Nominalized properties, also called 'nominalized functions' and 'entity correlates of properties' in the literature, are a sort in the domain of entities corresponding to the reification of the description of a standard $\langle e,t \rangle$ property. They were introduced by Gennaro Chierchia (Chierchia, 1984) as part of his Property Theoretic analysis of nominalization. Chierchia's motivation was to give a compositional account for sentences like (21):

(21) {Being nice/Goodness/That John is here/Red} is nice.

The operators $^{\cup\cap}$ are used to type-shift back and forth from properties as predicates to properties as individuals. Entity correlates of properties (generally adapted to a model-theoretic framework) have since been used for the analysis of existential sentences (McNally, 1992; McCloskey, 2014), kinds (Chierchia, 1998) and possessives (Koontz-Garboden and Francez, 2010), and have been argued to offer an alternative to semantic incorporation of $\langle e,t \rangle$-type objects (McNally, 2009) with different empirical consequences.

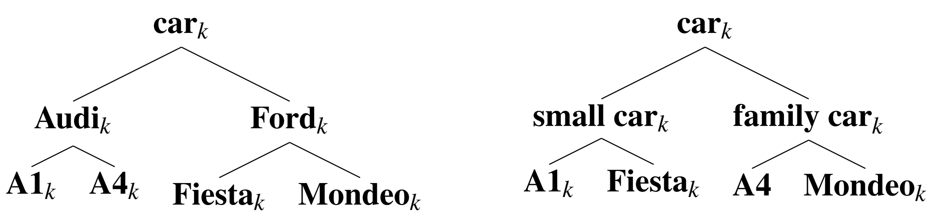
Nominalized properties are similar to kinds (Carlson, 1977); both are higher-order entities in D_e that are reified by token-level (possibly plural), particular individuals. How to tease the two notions apart has not been definitely established in the literature. It is generally agreed that kinds are a subset of nominalized properties; differences that have been suggested are the requirement that kinds have some degree of well-establishedness and a domain structured as a taxonomic hierarchy, whereas this does not necessarily hold for nominalized properties (Krifka, 1995; Chierchia, 1998; McNally, 2009; Müller-Reichau, 2011). In this section I will make a concrete proposal regarding the structure of the domain of entities, the relation between the different sorts inside this domain, and about NP-semantics. Full justification of each step would be beyond the scope of this article; see Bassaganyas-Bars (forthcoming).

I will assume a subdivision within D_e into token-level entities (e_o), kind-level entities (e_k) and nominalized properties (e_p). The latter two form the sub-domain of higher-order entities. Variants of the realization relation **R** (Carlson, 1977) connect higher-order individuals to token-level individuals, but also nominalized properties to kinds.

$$\begin{tikzcd} & e_p & \\ e_o \arrow[ur, "\mathbf{R}_{po}"] \arrow[rr, "\mathbf{R}_{ko}"] & & e_k \arrow[ul, "\mathbf{R}_{pk}"'] \end{tikzcd}$$

The relation $\mathbf{R}_{ko}$ is the Carlsonian **R**, the one that holds between an entity x_o and the kind y_k that it is an instance of. Unlike kinds, entities of sort e_p can include information on degree and number.[10] $\mathbf{R}_{po}$ is the relation that holds between e.g. a (complex) individual x_o which is the sum of two object cars, and the (nominalized) property of being two cars (**two cars**$_p$).

Introducing the role of $\mathbf{R}_{pk}$ requires first outlining how the sub-domain of kinds is organized. This sub-domain is structured by a (transitive, asymmetric) taxonomic relation **T** (Krifka et al., 1995): $\mathbf{T}(x,y)$ holds if x is a subkind of y. Turning away from artificially constructed Linnaean taxonomies, what counts as a subkind of what is context-dependent. If we take the kind **car**$_k$, either of these taxonomies –and many others– can be operative depending on context:



$\mathbf{R}_{pk}(x,y)$ holds if x is an individual or a sum consisting of a number n of individuals of sort e_k, which are in the **T** relation with a kind z_k, and y is the property of being n sub-kinds of z_k.

[10] For the present purposes, I will focus on count nouns, so I will consider only information on number.

In the taxonomies above, $\mathbf{A1}_k$ or $\mathbf{Ford}_k$ are in the $\mathbf{R}_{pk}$ relation to $\mathbf{one\ kind\ of\ car}_p$. Likewise, $\mathbf{R}_{pk}(\mathbf{A1}_k \bigoplus \mathbf{A4}_k, \mathbf{two\ kinds\ of\ Audi}_p)$ and $\mathbf{R}_{pk}(\mathbf{small\ car}_k \bigoplus \mathbf{family\ car}_k, \mathbf{two\ kinds\ of\ car}_p)$ also hold.

I will not consider well-establishedness as a prerequisite for kind-level denotation.[11] This implies that most instances of noun modification can be treated as kind-level modification. In addition, I will consider, following Müller-Reichau (2011: 51), that a set of sub-kinds (e.g. $\lambda x_k[\mathbf{dog}(x_k)]$) and the corresponding kind-qua-entity ($\mathbf{dog}_k$) are informationally equivalent. A variant of the $^{\cap\cup}$ operators allows us to type-shift between the two kinds of denotation.

This view draws heavily from the NP-semantics posited in Krifka (1995) which he terms 'concept-level', and which I will consider analogous to the view of nominalized properties I am defending. Combining Krifka's insights and the assumptions made so far, I will adopt the following logical representation of the denotation of 'two cars':

(22) $[\![\text{two cars}]\!] = \lambda y_p \forall x[(\mathbf{R}_{ko}\mathbf{T}(x, \mathbf{car}_k) \wedge \mathbf{two}(x)) \leftrightarrow \mathbf{R}_{po/pk}(x, y_p)]$

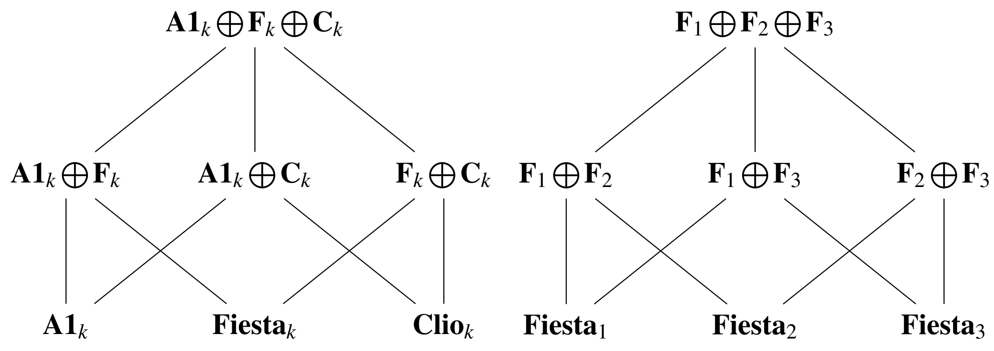
This representation means that, in a classifier-less language like English, 'two cars' denotes the set of higher-order entities y_p such that either (i) any complex entity x which realizes the kind $\mathbf{car}_k$, and is the sum of two atoms, is in the $\mathbf{R}_{po}$ relation to y_p, or (ii) any complex entity x comprised by sub-kinds of the kind $\mathbf{car}_k$ is in the $\mathbf{R}_{pk}$ relation to y_p.[12]

Whether (i) or (ii) is the right interpretation will depend on context. If a conversation is about a new neighbor, 'two cars' in 'she only has two cars' will most likely refer to the property of being two object cars; if it is about where to buy a new car, the same NP in 'this dealer only has two cars' can very plausibly refer to the property of being two sub-kinds of $\mathbf{car}_k$.

[11] Well-establishedness might be a prerequisite for some constructions (e.g. kind-denoting definite singular NPs), but not for kind-level denotation in general. That is, 'blue shoe with pink dots' can be as much of a kind as 'mountain shoe'.

(i) Blue shoes with pink dots are rare/common/trendy this year.

[12] What this amounts to is that 'two cars' in English can denote the set of individuals in the second row of either of these lattices (corresponding to the domain of kinds and the domain of objects):



The atomic individuals in the object domain are the members of the set of objects resulting from applying R_{ko} to one of the individuals in the kind-domain (in that case, $\lambda x.R_{ko}(x, Fiesta_k)$).

How do we get to the logical representation in (22)? I will follow the literature on so-called ‘layered’ approaches to the semantics of noun phrases in considering that the innermost layer of the NP denotes in the kind-domain. Common nouns denote predicates of kinds, adjectives can be treated as predicates of kinds as well, and composition with modifiers can be treated as predicate modification. As already mentioned, I follow Müller-Reichau’s (2011) claim that a set of subkinds and its corresponding kind-qua-entity are informationally equivalent. A variant of Chierchia’s $^{\cap}$ type-shifter applies to yield an output of type e_k.

$$\textbf{beautiful dog}_k$$

$$^{\cap} \quad \lambda x_k[\mathbf{dog}(x_k) \wedge \mathbf{beautiful}(x_k)]$$

$$\lambda x_k[\mathbf{beautiful}(x_k)] \quad \lambda x_k[\mathbf{dog}(x_k)]$$

Following Krifka (1995), and deviating somewhat from the usual layered-DP accounts, I suggest that the layer that contributes information on number does not involve turning the kind-level denotation inherited from the innermost layer into the set of objects realizing it. Instead, at this point we create the nominalized property y_p of being a number n of realizations or subkinds of a certain kind z_k. I will call this layer ClassP (Borer, 2005). Its head is a—covert or overt—classifier taking two arguments, a kind-level entity and a cardinality word (with N being a variable over cardinality predicates).[13]

(23) $[\![\text{Class}]\!] = \lambda z_k \lambda N \lambda y_p \forall x[((\mathbf{R}_{ko}\mathbf{T}(x, z_k) \wedge N(x)) \leftrightarrow \mathbf{R}_{po/pk}(x, y_p)]$

After combination with the two arguments, we reach (22), repeated here as (24).

(24) $[\![\text{two cars}]\!] = \lambda y_p \forall x[(\mathbf{R}_{ko}\mathbf{T}(x, \mathbf{car}_k) \wedge \mathbf{two}(x)) \leftrightarrow \mathbf{R}_{po/pk}(x, y_p)]$

(24) denotes a set. At this point, two things can happen: this set can either be the input to a definite or obligatorily quantificational determiner, or we can pragmatically bind the variable corresponding to the nominalized property with the iota-operator, reflecting the fact that the nominalized property introduced into the discourse is presupposed to be unique, thus yielding (25). As we will see in the next subsection, this is of the type HAVE looks for.

(25) $[\![\text{two cars}]\!] = \iota y \forall x[(R_{ko}T(x, \mathbf{car}_k) \wedge \mathbf{two}(x)) \leftrightarrow R_{po/pk}(x, y_p)]$

English has some overt classifiers; one of them is ‘kind/sort/type of’. This classifier restricts the interpretation of the NP to the property of being n sub-kinds of a certain kind.

[13]By making the cardinality word obligatory, the fact that overt classifiers in English need some kind of determiner is captured. That is, it rules out bare plurals with classifiers like ‘kind’, which are ungrammatical.

(i) a. *Kinds of whales are extinct.
 b. *John sells kinds of cars.

(26) $[\![\text{kind of}]\!] = \lambda z_k \lambda N \lambda y \forall x[(\mathbf{T}(x, z_k) \wedge \mathbf{N}(x)) \leftrightarrow \mathbf{R}_{pk}(x, y)]$

At this point I have finally introduced the necessary pieces to undertake the compositional analysis of HAVE-sentences.

6. Analysis

This is the logical representation I propose for HAVE, where π is an unspecified relation:

(27) $[\![\text{HAVE}]\!] = \lambda x_p \lambda y \lambda s[\pi(s) \wedge \text{PROTO-WHOLE}(s)(y) \wedge \text{PROTO-PART}(s)(x_p)]$

This denotation assumes the view on argument structure in Dowty (1991). However, the proto-roles used here are the ones proposed in Barker and Dowty (1993) for possessive NPs. Although it is not crucial, this move has two welcome consequences. First, it captures the fact that the relations expressible with a HAVE-sentence overlap with those that can be conveyed by possessive NPs (for which the PROTO-WHOLE and PROTO-PART proto-roles were designed).[14] Second, it naturally filters out odd sentences like (28a)–(28c):

(28) a. #Three windows have a house.
b. #A problem has John.
c. #The tail has a cat.

With all the assumptions in place, let us begin with HAVE-sentences with a discourse-new object-NP containing a relational noun, as in (29). Relational nouns are treated as are one-place predicates with an associated meaning postulate, as (30) illustrates:

(29) John has two smart sisters.

(30) a. $[\![\text{sister}]\!] = \lambda x.\mathbf{sister}(x)$
b. $\forall x \forall w[\mathbf{sister}_w(x) \leftrightarrow \exists y[\mathbf{siblinghood}_w(y)(x)]]$

Applying the NP-semantics outlined in the previous section, we start from 'sister' as a set of (sub-)kinds and combine it with 'smart' (modeled as a predicate of kinds as well) by predicate modification, yielding (31). Following the assumptions above, $^\cap$ steps in, returning (32):

(31) $[\![\text{smart sister}]\!] = \lambda x_k.\mathbf{sister}(x_k) \wedge \mathbf{smart}(x_k)$

(32) $[\![\text{smart sister}]\!] = \mathbf{smart\ sister}_k$

Class, defined in (23) above, takes (32) as an argument, and the result combines with the

[14]Note that 'John has two houses' denotes different relations if we refer to John as a regular guy, a realtor, a kid with divorced parents, etc, and that all of these relations can be expressed by a possessive NP like 'John's two houses'. However, the opposite might not be true, as Heine (1997) points out, because the NP can also mean in context 'the two houses that John likes', but it is not clear whether this relation can be expressed by the HAVE sentence 'John has two houses'. The relevant point is that the same roles hypothesized for nominal possession could be used for HAVE-sentences.

cardinality predicate, eventually yielding (34):

(33) $\lambda z_k \lambda N \lambda y_p \forall x[((\mathbf{R}_{ko}\mathbf{T}(x,z_k) \wedge N(x)) \leftrightarrow \mathbf{R}_{po/pk}(x,y_p)]$ $(\textbf{smart sister}_k) =$
$\lambda N \lambda y_p \forall x[((\mathbf{R}_{ko}\mathbf{T}(x,\textbf{smart sister}_k) \wedge N(x)) \leftrightarrow \mathbf{R}_{po/pk}(x,y_p)]$

(34) $\lambda N \lambda y_p \forall x[((\mathbf{R}_{ko}\mathbf{T}(x,\textbf{smart sister}_k) \wedge N(x)) \leftrightarrow \mathbf{R}_{po/pk}(x,y_p)]$ $(\lambda z.\textbf{two}(z)) =$
$\lambda y_p \forall x[((\mathbf{R}_{ko}\mathbf{T}(x,\textbf{smart sister}_k) \wedge \textbf{two}(x)) \rightarrow \mathbf{R}_{po/pk}(x,y_p)]$

The contextually triggered iota-operator applies at this point, yielding (35):

(35) $\iota y_p \forall x[((R_{ko}T(x,\textbf{smart sister}_k) \wedge \textbf{two}(x)) \rightarrow R_{po/pk}(x,y_p)] =$
$\textbf{two smart sister}_p$

This is the input that HAVE can take, giving us (37) after combination with the subject:

(36) $\lambda x_p \lambda y \lambda s[\pi(s) \wedge \text{PROTO-WHOLE}(s)(y) \wedge \text{PROTO PART}(s)(x_p)]$ $(\textbf{two smart sister}_p) =$
$\lambda y \lambda s[\pi(s) \wedge \text{PROTO-WHOLE}(s)(y) \wedge \text{PROTO-PART}(s)(\textbf{two smart sister}_p)]$

(37) $\lambda s[\pi(s) \wedge \text{PROTO-WHOLE}(s)(\textbf{john}) \wedge \text{PROTO-PART}(s)(\textbf{two smart sister}_p)]$

After this set of states is existentially closed at some point further in the derivation, (37) introduces an entity of sort e_p into the discourse and an unspecified relation π linking it to John. Following McNally (1992), I suggest that adding a HAVE-sentence into the discourse entails the introduction of a discourse referent satisfying the description. A token-level individual in the $\mathbf{R}_{po}$ relation to $\textbf{two smart sisters}_p$ thus enters the discourse model.

This is the point where the value of π is determined. 'Sister' is a relational noun. Condition (16) above established that entities describable by such predicates can only be introduced into the discourse by anchoring them to the other argument in the relation they entail. This is what the HAVE-sentence does. Therefore, as a result of updating the discourse with (37), a relation (π) between John and two token-level individuals satisfying the descriptive content of $\textbf{two smart sisters}_p$ is asserted. Then, by virtue of the entailments on the introduction of a relational noun into the discourse, this relation is set to 'siblinghood': π gets its value. We reach the desired interpretation in an indirect way which allows us to account for the fact that the object of HAVE does not behave as a token-level individual, as shown in section 3.

The derivation of a sentence with a discourse-new sortal noun, like (38), is only minimally different. Following the same steps as for (29) above, we reach the representation in (39).

(38) John has three bicycles.

(39) $\lambda s[\pi(s) \wedge \text{PROTO-WHOLE}(s)(\textbf{john}) \wedge \text{PROTO-PART}(s)(\textbf{three bicycles}_p)]$

As a result, the nominalized property $\textbf{three bicycles}_p$, and an unspecified relation π between this property and John, are added into the discourse model; by the entailments of the use of

HAVE-sentences, three object bicycles are introduced as well. 'Bicycle' is a sortal noun, so there is no meaning postulate to fall back on to retrieve a value for π. The object is discourse-new, so no context-dependent relations involving bicycles are being discussed. In such cases, world-knowledge is resorted to. Assuming that John is an individual with no particular relation to bicycles (he is not a professional cyclist, bicycle repairer or seller, etc.), the value of π will be set to the 'person-bicycle-relation', the one most of us have with our bikes (entailing exclusive right of use, responsibility for taking care of it, etc.). If John had been a cyclist, π would have been set to 'cyclist-bicycle-relation', with different entailments, and so forth.

So far we have considered the most straightforward cases among the ones discussed in section 3. It will be useful to consider how this analysis treats other cases where HAVE-sentences get a non-contextualized reading. One of them involves sentences like (40).

(40) John has three kinds of brothers.

Note that condition (16) does not apply to kind-level NPs with relational nouns. (41) relies on a discourse context containing individuals of sort e_k corresponding to sub-kinds of brothers. Whether it contains token-level individuals realizing them is immaterial. 'Kinds of brothers' can be introduced without having to anchor them to any other individual.

(41) Some kinds of brothers are harder to put up with than others.

Still, the natural interpretation of (40) is the one where John is one of the arguments of a siblinghood relation. How does this come about? Adding (40) to a context introduces the nominalized property **three kinds of brother**$_p$ and a relation π linking it to John. By entailment, a token-level discourse referent has to be added. The only way to satisfy this is by adding a complex individual whose atoms are (an unspecified number of) realizations of three different sub-kinds of brothers, with at least one token-level individual per sub-kind (e.g. two nice brothers, one bully brother, and two nerdy brothers). This means that token-level entities that satisfy the description 'brother' enter the discourse, and at this point, by virtue of the meaning postulate associated with token-level relational nouns, π is interpreted as 'siblinghood' and John is interpreted as the other member of the relation for each of the token-level entities eventually introduced into the discourse model.

Sentence (42) differs from (40) in the presence of the definite article, which nonetheless does not block a non-contextualized interpretation.

(42) John has the three kinds of brothers.

The interpretation is derived similarly: the definite article implies that previous context contains entities corresponding to three sub-kinds of brother, but not necessarily entities realizing them. The nominalized property **the three kinds of brother**$_p$, which refers to the property of being the specific three kinds of brother being discussed, is made the object of a HAVE-sentence, and this entails the introduction of an unspecified number of object-level entities such that there is at least one for each of the three sub-kinds. Again by virtue of the meaning postulate associated with relational nouns, the relation between the entities and the subject of the sentence will be 'siblinghood'. What (42) illustrates is that, in its role of introducing relations into the discourse with a non-contextualized interpretation, HAVE cares more about the sort of its object-NP (it needs to be higher-order) than about its being discourse-new.

Let us now consider HAVE-sentences with obligatorily quantificational determiners which nonetheless yield non-contextualized interpretations, such as (43).

(43) John has every kind of brother.

The result of combining the overt classifier 'kind of' to a kind-denoting NP, as defined in section 5, yields the following representation:

(44) $[\![\text{kind of brother}]\!] = \lambda N \lambda y_p \forall x[(\mathbf{T}(x, \mathbf{brother}_k) \wedge N(x)) \rightarrow \mathbf{R}_{pk}(x, y_p)]$

'Every' requires arguments of type $\langle e,t \rangle$, so there will be a type-mismatch. I will assume that, in cases where phrases headed by overt classifiers combine with quantificational determiners, there is a covert cardinality predicate (**At**) predicating atomicity, which saturates the N in the derivation.[15] As a result, we get the desired type:

(45) $[\![\text{kind of brother}]\!] = \lambda y_p \forall x[(\mathbf{T}(x, \mathbf{brother}_k) \wedge \mathbf{At}(x)) \rightarrow \mathbf{R}_{pk}(x, y_p)]$

Since (45) denotes a set of entity correlates of properties, 'every' will quantify over higher-order entities, as illustrated by the simplified representation in (46). Sentences like (43) are thus licensed. The non-contextualized interpretation comes about as in (40) and (42) above.

(46) $\text{Every}\, x_p[\lambda y_p \forall x[(\mathbf{T}(x, \mathbf{brother}_k)) \wedge \mathbf{At}(x)) \rightarrow \mathbf{R}_{pk}(x, y)]]\,(\pi(x_p)(\mathbf{John}))$

Derivation of sentences like (47a)–(47c) rely on the existence of covert kind classifiers. With all the assumptions about the interpretation of HAVE-sentences with kind-denoting NPs discussed in this section, their interpretation should be straightforward.

(47) a. John has the hair of a metal star from the 80's.
b. John has the hair of Joey Tempest/Joey Tempest's hair.
c. John has the hair he always dreamed of.

Space only allows for a brief remark on contextualized readings, cases like (3a), (3b), (19b) or (20) above. It was mentioned in section 3 that only some languages have a version of HAVE that supports these readings. On this analysis, it will be a version of HAVE that preserves its function of introducing relations linked to an entity in the discourse, but in this case the other entity in the relation will be of sort e_o instead of e_p, as in (48).

(48) $[\![\text{HAVE}_{context.}]\!] = \lambda x_o \lambda y \lambda s[\pi(s) \wedge \text{PROTO-WHOLE}(s)(y) \wedge \text{PROTO-PART}(s)(x_o)]$

[15] This covert atomicity predicate has an overt expression in 'every single kind of'. Note as well that there are cases of 'every' taking NPs with overt cardinality predicates (e.g. 'every two days').

The main difference lies in the value π can take: the strategies used above with discourse-new NPs are not available, so previous context, or an all-encompassing notion of 'control', has to be called on. There are languages that distinguish these two uses of HAVE overtly: Spanish, for instance, does it through the presence or absence of Differential Object Marking.[16]

7. Conclusions

The syntactic and semantic peculiarities of HAVE can be explained by analyzing it as a relation between token-level individuals and nominalized properties, and by considering that the way this relation is specified depends on the noun being sortal or relational. I have focused on cases where HAVE embeds NPs. Whether this approach can be extended to other uses of HAVE remains for future research (see Bassaganyas-Bars (forthcoming)).

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[16]In Spanish, Differential Object Marking is forbidden in non-contextualized interpretations (i), but preferable in contextualized ones (ii).

(i) Tengo (*a) tres profesores muy buenos.
I-have (DOM) three teachers very good
'I have three very good teachers.'

(ii) Para la fiesta, ya tengo ?(a) tres profesores.
for the party, already I-have (DOM) three teachers
'I already have three teachers for the party.'

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A unified existential semantics for bare conditionals[1]

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Abstract. Bare conditionals show an unexpected quantificational variability contingent on whether they are embedded in an Upward Entailing context (universal import) or a Downward Entailing context (existential import). Contra Herburger (2015a, b)'s ambiguity theory, we argue in favor of a unified semantics for bare conditionals based on their behavior in VP ellipsis constructions and in non-monotonic contexts. We show that a similar pattern exists with Free Choice phenomena, and consequently suggest a parallel analysis to Fox (2007)'s treatment of such phenomena. We propose that bare conditionals have a basic existential semantics which is obligatorily strengthened into a universal meaning in UE contexts, while being preserved in DE contexts. Our claim that bare conditionals are underlyingly existential is further supported by Conditional Perfection data with bare and non-bare conditionals.

Keywords: conditionals, homogeneity, exhaustivity, alternatives, conditional perfection, quantification, free choice

1. Higginbotham's puzzle and existing solutions

A bare conditional as in (1a) involves *universal* (or universal-like) generalization over cases (or worlds).[2] As first observed by Higginbotham (1986), this meaning is preserved when the conditional is embedded in the scope of *every*, as in (1b), but when embedded in the scope of *no* as in (1c) it seems as though the conditional contributes an *existential* force.[3] Having a universal meaning for the conditional in (1c), as in (1cii), will result in a too-weak meaning which is compatible with someone having a case where they goof off and succeed.

(1) a. If you work hard you succeed.
≈ In **all** cases where you work hard, you succeed.
b. Everyone will succeed if they work hard.
≈ For every x, in **all** cases where x works hard, x succeeds.
c. No one will succeed if they goof off.
(i) ≈ There is no x s.t. **there is** a case where x goofs off and x succeeds.
(ii) ≉ There is no x s.t. in **all** cases where x goofs off, x succeeds.

Higginbotham (1986) presents the paradigm in (1) as a problem for compositionality, and this surprising behavior has troubled semanticists ever since (see Kratzer 2015; Leslie 2008; Herburger 2015a, b, a.o.).

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[2]We limit ourselves here to conditionals that have some intensional import, and ignore quantified conditionals of the kind discussed in Kratzer (2015) which seem to only care about the actual world.

[3]Higginbotham's own description is in terms of material implication vs. conjunction, but the puzzle persists in a more standard framework where conditionals aren't truth-functional but involve quantification over worlds.

It has been argued by von Fintel and Iatridou (2002) (and more recently by Herburger 2015a) that the behavior of the embedded conditional in (1c) is not unique to conditionals in the scope of *no*, but extends to other Downward Entailing (DE) environments, for example when a bare conditional is embedded under *doubt*:

(2) I doubt that Mary will come if John comes.
  a. ≈ I doubt that **there is** a case where John comes and Mary comes.
  b. ≉ I doubt that in **all** cases where John comes Mary comes.

The generalization that emerges is that systematically, bare conditionals contribute universal quantification in UE environments and existential quantification in DE environments. To conclude, we are left with a puzzle, which we'll call Higginbotham's puzzle:

(3) **Higginbotham's puzzle**: How can bare conditionals contribute universal quantification in UE environments and existential quantification in DE environments compositionally?

Two main lines of compositional analyses with a unified semantics for conditionals have been proposed: (i) Analyses in which conditionals obey Conditional Excluded Middle (CEM) (Stalnaker 1968, von Fintel 1997, von Fintel and Iatridou 2002, Klinedinst 2011); (ii) proposals along the lines of the restrictor analysis of conditionals, according to which the quantificational force in question is supplied by a surrounding quantifier, with the *if*-clause serving as a domain restrictor (Leslie 2008; Kratzer 2015).

For reasons of space, we cannot discuss at length the advantages and shortcomings of those analyses.[4] Instead, our discussion in this paper will mainly relate to an alternative analysis which was recently advanced by Herburger (2015a, b). Herburger's solution to Higginbotham's puzzle is that conditionals are simply ambiguous:

(4) **Herburger's hypothesis**: Bare conditionals are lexically ambiguous.
  a. In UE environments they contribute universal quantification.
  b. In DE environments they contribute existential quantification.[5]

In this paper we argue against Herburger's ambiguity hypothesis and provide a novel unified semantics that deals with Higginbotham's puzzle. Our empirical motivation for rejecting the ambiguity hypothesis comes from the observation that bare conditionals don't behave like classical ambiguities in VP ellipsis constructions and in non-monotonic contexts (section 2). We adopt Herburger's idea (which is already entertained in von Fintel 1997) that existential bare conditionals exist, and contend that *only* they exist: bare conditionals are *existential across the board*. We present an analogy between bare conditionals and Free Choice disjunction in different contexts as a motivation for this assumption (section 3). To derive the universal im-

[4]See Leslie (2008); Herburger (2015a, b) for arguments against CEM analyses, and von Fintel and Iatridou (2002); Huitink (2010) for a problematization of the restrictor analysis. We hope to conduct a more thorough comparison between these approaches and ours in future work.

[5]One might wonder about the principle that governs the distribution of the two possible meanings as characterized in (4). Even though Herburger herself doesn't explicitly suggests this, it seems natural to think of the Strongest Meaning Hypothesis (Dalrymple et al., 1994)) as a relevant principle. See also footnote 13.

port of bare conditionals in UE contexts from their basic existential meaning, we utilize the grammatical strengthening mechanism proposed by Fox (2007) for the analysis of Free Choice inferences, using exhaustification over sub-domain alternatives (as in Chierchia 2013) (section 4). We further show that Conditional Perfection data, which pose a difficulty for Herburger's ambiguity approach (as well as for standard universal semantics approaches), are naturally explained by our proposal, and that comparing Conditional Perfection in bare and non-bare conditionals provides another evidence for the existentiality of bare conditionals (section 5).

2. Shortcomings of an ambiguity theory

Herburger's hypothesis in (4) straightforwardly accounts for Higginbotham's puzzle. However, in this paper we argue that it cannot be maintained and that a unified analysis is called for. The basis on which we make this claim consists of the considerations in (5):

(5) a. Bare conditionals do not behave like ambiguities in ellipsis constructions where the antecedent and the elided material are in environments of different monotonicity.
   b. When embedded in non-monotonic contexts, bare conditionals give rise to a universal interpretation in the UE component of the meaning and an existential interpretation in the DE component of the meaning, which is an unexpected behavior for ambiguities.
   c. To derive the phenomenon known as Conditional Perfection, an ambiguity approach is forced to assume that the meaning of a bare conditional is resolved universally in computing the assertion and existentially in computing its implicature.

In this section we elaborate on (5a) and (5b), deferring the discussion of (5c) to section 5. The common core of all of these arguments is that in cases where one occurrence of a bare conditional is involved in some way in both UE and DE parts of the interpretation, the meaning it contributes splits: universality for the UE part, and existentiality for the DE part. This is not the way ambiguities usually behave, and an ambiguity analysis clearly misses a generalization here. This pattern is above all reminiscent of Higginbotham's (1986) characterization of *if*'s behavior as "chameleon-like".

Let us discuss (5a) first. A familiar test for ambiguity is ellipsis: when an ambiguous phrase is elided, the ambiguity is resolved uniformly in the antecedent VP and the elided VP (Sag 1976; Heim 1996). However, bare conditionals fail this test: when bare conditionals are elided and the antecedent VP and the elided VP are in contexts with different monotonicity (namely when one of them is in a UE context and the other in a DE context), as in (6), they give rise to different quantificational forces. The conditional in the antecedent VP, which is in a UE context, is interpreted universally (6a), while the elided one, which is in a DE context, is interpreted existentially (6b).

(6) Every boy calls his mother if he gets an A, and no girl does. ≈
   a. For every boy x, in **all** cases where x gets an A, x calls x's mother, and
   b. there is no girl x s.t. **there is** a case where x gets an A and x calls x's mother.

An ambiguity analysis would predict either a universal meaning for both VPs, or an existential meaning for both. However, neither of these meanings is in fact attested, while the attested meaning is not predicted.

Turning to (5b), when a bare conditional is embedded in a non-monotonic context as in (7), the salient reading is one where the conditional seems to contribute a universal meaning for the UE component of the meaning and an existential meaning for the DE component.

(7) Exactly two students call their mother if they get an A. ≈
 a. **UE component**: There are two students x, s.t. in **all** cases where x gets an A, x calls x's mother.
 b. **DE component**: There are no more than two students x s.t. **there is** a case where x gets an A and x calls x's mother.

Here too, an ambiguity analysis would presumably predict either a universal meaning for both components or an existential meaning for both, but not the attested reading where each component draws a different quantificational force from the bare conditional.

This is the puzzling situation in which we find ourselves now: In UE contexts bare conditionals behave like universal quantifiers, and in DE contexts they behave like existential quantifiers. An ambiguity analysis then seems appealing, but their behavior in VP ellipsis constructions and in non-monotonic contexts suggests that it is not on the right track.[6] A more promising direction is to assume one basic meaning and derive the other one from it. But which one should we choose as the basic meaning, the universal or the existential one, and how to derive the one from the other?

It might seem intuitive to choose the universal meaning as the starting point. However, we see no empirical or theoretical reason to assume that the basic semantics of bare conditionals surfaces in UE contexts rather than DE contexts. Our proposal will in fact follow the less intuitive strategy, and take the weak existential meaning to be the basic one. To prepare the ground, in the next section we provide a preliminary reason for this choice, based on the similar behavior of bare conditionals and Free Choice disjunction which is standardly assumed to involve a basic weak semantics. In section 5.4 we provide evidence supporting an existential semantics from comparing Conditional Perfection with bare and non-bare conditionals.

3. Towards a unified account: Analogy with Free Choice disjunction

Embedding the disjunctive marker *or* under an existential modal gives a stronger-than-expected conjunctive inference. This phenomenon is known as Free Choice (FC) and is illustrated in (8a). Since at least Kratzer and Shimoyama (2002), it has been argued that the FC inference of

[6] Note, however, that to account for (6) and (7) one can salvage the ambiguity analysis with a more involved story such as the supervaluationist one suggested in Spector (2013) for homogeneity in definite plurals. Very roughly, the idea would be that for a sentence containing a bare conditional to be super-true, it should be true under both possible meanings. Even though we have no argument to show against this kind of analysis, our proposal in section 4 avoids assuming an unwarranted ambiguity, and instead utilizes mechanisms that are independently argued for. We leave a thorough comparison between the two approaches to further research.

(8a) has the status of a scalar implicature, since it tends to disappear under DE operators, (8c):

(8) a. John is allowed to eat ice-cream or cake $\Diamond(A \vee B)$
≈ John is both allowed to eat ice-cream **and** allowed to eat cake $\Diamond A \wedge \Diamond B$
b. Everyone is allowed to eat ice-cream or cake $\forall x[\Diamond(A(x) \vee B(x))]$
≈ Everyone is both allowed ice-cream **and** allowed cake $\forall x[\Diamond A(x) \wedge \Diamond B(x)]$
c. No one is allowed to eat ice-cream or cake $\neg\exists x[\Diamond(A(x) \vee B(x))]$
≉ No one is both allowed ice-cream **and** allowed cake $\neg\exists x[\Diamond A(x) \wedge \Diamond B(x)]$

The pattern in (8) parallels the data from bare conditionals in (1). In both, a universal/conjunctive meaning appears in UE contexts and disappears in DE contexts. Moreover, consider the ellipsis example in (9) and the non-monotonic example in (10) in comparison to (6) and (7).

(9) Every boy is allowed to eat ice cream or cake, and no girl is. ≈
a. For every boy x, x is both allowed to eat ice cream **and** allowed to eat cake, and
b. there is no girl x s.t. x is allowed to eat ice cream **or** cake.

(10) Exactly two children are allowed to eat ice cream or cake. ≈
a. **UE component**: There are two children x, s.t. x is both allowed to eat ice cream **and** allowed to eat cake.
b. **DE component**: There are no more than two children x s.t. x is allowed to eat ice cream **or** cake.

In both FC and bare conditionals, then, whenever one occurrence is involved in providing meaning to both UE and DE components of the meaning, we get a conjunctive/universal meaning for the UE component and a disjunctive/existential meaning for the DE component. This similarity points towards a unified treatment of both phenomena. We follow Fox (2007) and others in assuming that FC disjunction involves the regular weak semantics of disjunction, and consequently assume a weak existential semantics for bare conditionals in analogy to it (for a more direct motivation see section 5.4). In the next section we propose an account of the quantificational split in bare conditionals using the same mechanism that derives FC inferences in Fox (2007), namely grammatical strengthening via recursive exhaustification. For reasons of space, we cannot spell out a full derivation of FC, rather we refer the reader to Fox (2007) for details and move on to present our analysis of bare conditionals.[7]

4. Proposal

4.1. The plot

We propose that bare conditionals not only *can* have existential semantics as Herburger (2015a) has it, but rather this is the *only* semantics they have. The universal interpretation of bare conditionals in UE contexts is arrived at by grammatical strengthening, via recursive exhaustification over alternatives. Our answer to Higginbotham's puzzle is summarized in (11).

[7]Embedded FC data as in (8b) (and also (9) and (10)) don't follow from Fox's analysis without additional assumptions (see, e.g., Chemla 2009). We will return to this issue later (see footnote 15).

(11) **Proposal in a nutshell**:
a. Bare conditionals are underlyingly existential across the board.
b. In UE contexts they undergo grammatical strengthening and become universal.
c. In DE contexts their basic existential meaning is preserved.

In section 4.2 we lay out the details of the proposal. We do so in steps: we first introduce our assumptions about the core existential meaning of a bare conditional and the alternatives it triggers. Then we proceed to show how, with the help of recursive exhaustification, we can get from the basic existential meaning to the stronger universal meaning in UE environments, while preserving the basic existential meaning in DE environments. In section 4.3 we show how the analysis deals with the challenges from section 2. In section 4.4 we discuss the structure of alternatives we're assuming and its implications on the difference between bare and non-bare conditionals.

4.2. A unified existential semantics

We assume a semantics in which bare conditionals quantify existentially over antecedent worlds, restricted by a domain of quantification D_s. As can be seen in (12), we assume that D_s is syntactically realized and serves to restrict the domain of quantification for *if*:[8]

(12) $[\![If_{D_s}\ p,\ q]\!] = 1$ *iff* $\exists w \in [\![p]\!] \cap D_s [[\![q]\!](w) = 1]$

(12) straightforwardly accounts for the cases where existential quantification was needed, such as (2). To derive the universal meaning in UE contexts, we hypothesize that bare conditionals trigger Sub-Domain Alternatives (SDAs) of the conditional, in the spirit of Chierchia (2013)'s analysis of Polarity Sensitive Items (see also Bar-Lev and Margulis 2014).

(13) **Hypothesis**: if_{D_s} gives rise to Sub-Domain Alternatives (SDAs).

The SDAs we assume are derived by replacing the original domain variable D_s with its subsets:

(14) **Sub-Domain Alternatives:** $Alt(if_{D_s}\ p,\ q) \supseteq \{if_{D'_s}\ p,\ q \mid D'_s \subseteq D_s\}$

By way of illustration, take (1a) (repeated in (15)) as an example and assume a toy model with a set $\{h_1, h_2\}$ of two working hard worlds, in (16a), and a set $\{nh_1, nh_2\}$ of two non-working hard worlds, in (16b). Then the basic meaning of (15) is in (17a), and its domain alternatives, generated by replacing the D_s with its subsets (as prescribed by (14)), are in (17b):

(15) If you work hard you succeed. [=(1a)]

(16) $D_s = \{h_1, h_2, nh_1, nh_2\}$

[8] We will have nothing to say here about how the domain of quantification D_s is determined. We also don't commit to what exactly is quantified over: it could be worlds, situations, events, etc. For concreteness we stick to worlds throughout our discussion.

a. $[\![\textit{You work hard}]\!] = \{h_1, h_2\}$
b. $[\![\textit{You don't work hard}]\!] = \{nh_1, nh_2\}$

(17) a. **Basic meaning of (15)**
$\exists w \in [\![\textit{You work hard}]\!] \cap D_s[\text{you succeed in } w]$
$= \exists w \in \{h_1, h_2\}[\text{you succeed in } w]$
$=$ You succeed in h_1 $\vee$ You succeed in h_2 (*in short:* $\mathbf{a} \vee \mathbf{b}$)
b. **Sub-Domain Alternatives of (15)**
$\left\{\text{if}_{D'_s} \text{ you work hard you succeed} \;\middle|\; D'_s \subseteq \{h_1, h_2, nh_1, nh_2\}\right\}$

Looking at the denotations of the elements in (17b), we can translate (17b) to (18).[9] Note that the relationship between the basic meaning (17a) and the SDAs (18b-c) can be rendered in terms of the relationship between a disjunction and its disjuncts. For this reason, we shorten the former to $\mathbf{a} \vee \mathbf{b}$ and the latter to **a** and **b**.

(18) **Sub-Domain Alternatives of (15)**
a. $\exists w \in \{h_1, h_2\}[\text{you succeed in } w]$ ($=$ (17a))[10] $\mathbf{a} \vee \mathbf{b}$
b. $\exists w \in \{h_1\}[\text{you succeed in } w]$ = You succeed in h_1 **a**
c. $\exists w \in \{h_2\}[\text{you succeed in } w]$ = You succeed in h_2 **b**

The domain alternatives have to be used up by an alternative sensitive operator, i.e., they are *obligatorily exhaustified* (as in Chierchia 2013).[11] Following Fox (2007), we assume a covert EXH operator as defined in (19). EXH takes the prejacent and a set of alternatives and returns the prejacent conjoined with the negation of all INNOCENTLY EXCLUDABLE (IE) alternatives. Informally, the restriction to IE alternatives amounts to the requirement that exclusion of alternatives does not contradict the prejacent and that the choice of alternatives to exclude is not arbitrary.

(19) $[\![\text{EXH}]\!](Alt(p))(p)(w) \Leftrightarrow p(w) \wedge \forall q \in \text{IE}(p, Alt(p))[\neg q(w)]$
(Where $Alt(p)$ is the set of alternatives of the prejacent p)

(20) $\text{IE}(p, Alt(p)) = \bigcap\{Alt(p)' \subseteq Alt(p) : Alt(p)'$ is a maximal set in $Alt(p)$, s.t. $\{\neg q : q \in Alt(p)'\} \cup \{p\}$ is consistent$\}$

The parse we propose for bare conditionals that yields universal interpretation contains two EXH operators:

[9] Here and throughout we neglect SDAs in which the sub-domain D'_s is such that $[\![p]\!] \cap D'_s = \varnothing$. These alternatives are not represented because they are contradictory, and therefore don't affect the alternative computation mechanism (to be discussed shortly).

[10] This is technically a SDA because by definition, the prejacent is a SDA of itself. But when talking about SDAs, we will sometime mean only "proper" sub-DAs, i.e. excluding the prejacent.

[11] It is crucial that exhaustification here would be obligatory and that the SDAs cannot be ignored ('pruned'), since otherwise we would wrongly predict that the universality of bare conditionals could be cancelled:
(i) #If you work hard you succeed, and if you work hard you might fail.
We leave open the important issue of how to motivate and implement this obligatoriness, and refer the reader to the discussion in Chierchia (2013). See also footnote 23.

(21) $\text{EXH}_{C'}$ [$_\alpha$ EXH_C [if$_{D_s}$ you work hard you succeed]]

(Where C in EXH_C [ϕ] is the set of alternatives of ϕ, namely $Alt(\phi)$)

The semantic computation of (21) is given in (22), using the toy model and the abbreviations introduced above. The final step of (22) reveals that the basic existential meaning of the conditional was strengthened via double exhaustification to a universal meaning.

(22) a. $[\![$*If$_{D_s}$ you work hard you succeed*$]\!] = 1$ *iff* $\exists w \in \{h_1, h_2\}[\text{You succeed in } w] =$ You succeed in $h_1 \vee$ You succeed in $h_2 = \mathbf{a} \vee \mathbf{b}$ (cf. (17a))

b. $C = Alt(\mathbf{a} \vee \mathbf{b}) = \{\mathbf{a} \vee \mathbf{b}, \mathbf{a}, \mathbf{b}\}$ (cf. (18))

c. $[\![\alpha]\!] = \text{EXH}_C[\mathbf{a} \vee \mathbf{b}] = \mathbf{a} \vee \mathbf{b}$ (EXH is vacuous because the SDAs are not IE)

d. $C' = Alt(\text{EXH}_C[\mathbf{a} \vee \mathbf{b}])$
$= \{\text{EXH}_C[\mathbf{a} \vee \mathbf{b}], \quad \text{EXH}_C[\mathbf{a}], \quad \text{EXH}_C[\mathbf{b}]\}$
$= \{\mathbf{a} \vee \mathbf{b}, \quad \mathbf{a} \wedge \neg \mathbf{b}, \quad \mathbf{b} \wedge \neg \mathbf{a}\}$

e. $[\![$*(21)*$]\!] = \text{EXH}_{C'}[\text{EXH}_C[\mathbf{a} \vee \mathbf{b}]] = (\mathbf{a} \vee \mathbf{b}) \wedge \neg(\mathbf{a} \wedge \neg \mathbf{b}) \wedge \neg(\mathbf{b} \wedge \neg \mathbf{a})$
(All the alternatives in C' except $\mathbf{a} \vee \mathbf{b}$ are IE)
$= (\mathbf{a} \vee \mathbf{b}) \wedge (\mathbf{a} \leftrightarrow \mathbf{b}) = \mathbf{a} \wedge \mathbf{b}$

f. $= \forall w \in \{h_1, h_2\}[\text{you succeed in } w]$[12]

Let us go through the steps in (22). Applying EXH once with respect to the set of alternatives in (22b) is in (22c), which corresponds to the phrase we named "α" in (21). Since no alternative is Innocently Excludable (cf. (20)), the result equals to the input—the prejacent. However, the set of alternatives of α is different from the one in (22b); this set is provided in (22d). The set in (22d) turns out to contain the original sentence ($\mathbf{a} \vee \mathbf{b}$), and in addition, 'only **a**' ($\mathbf{a} \wedge \neg \mathbf{b}$), and 'only **b**' ($\mathbf{b} \wedge \neg \mathbf{a}$). Finally, applying EXH for the second time, this time with respect to the set in (22d), yields (22e). The derived meaning is, roughly, **a** *or* **b***, and not only* **a***, and not only* **b**, which is equivalent to $\mathbf{a} \wedge \mathbf{b}$. We have started with a disjunctive assertion, equivalent to an existential one, and ended up with a conjunctive meaning, that is—a universal one, (22f). The derivation straightforwardly extends to models with more than two antecedent worlds.

Importantly, the strengthening mechanism does not make the wrong predictions for the DE cases that initially motivated the existential semantics assumption, as in (1c) and (2). DE environments flip entailment relations, so that the prejacent entails (rather than entailed by) all the domain alternatives, see (23c). Therefore applying matrix EXH (any number of times) would not contribute anything to the semantics, cf. (23d). Thus, no strengthening from existential to universal applies when the bare conditional is embedded in a DE environment.[13]

[12] In (22f) and throughout the paper, we omit the prejacent's contribution, namely $\exists w \in \{h_1, h_2\}$[you succeed in w], whenever we provide a strengthened meaning for it. This is harmless, since we assume as is standard that quantification triggers a non-vacuity presupposition. Furthermore, given this presupposition, the antecedent of a conditional becomes a Strawson-DE environment after the application of recursive EXH. This makes our analysis in line with the generalization that NPIs are licensed in the antecedent of a conditional, if the mechanism responsible for NPI licensing applies above the exhaustivity operators.

[13] One might wonder what blocks recursive EXH to appear in an embedded position under the DE operator, which would give us the $\neg\forall$ meaning we claim is absent. On our analysis, this question reduces to the issue of *embedded implicatures* in DE environments (Fox and Spector 2013, Chierchia 2013 a.o.), which are known to arise only in special, non-neutral contexts, and require a specific intonation.

(i) a. He didn't talk to Mary or Sue. # He talked to both

(23) a. No one will succeed if they goof off [=(1c)]
b. $[\![$*no one will succeed if$_{D_s}$ they goof off*$]\!]$
$\Leftrightarrow \neg\exists x[\exists w \in [\![goof\ off]\!](x) \cap D_s[x \text{ succeeds in } w]]$
c. (23b) $\Rightarrow \forall D'_s \subseteq D_s[\neg\exists x[\exists w \in [\![goof\ off]\!](x) \cap D'_s[x \text{ succeeds in } w]]]$
(All domain alternatives of (23b) are entailed by (23b))
d. $[\![$*no one will succeed if$_{D_s}$ they goof off*$]\!]$
$\Leftrightarrow [\![$(EXH) EXH *no one will succeed if$_{D_s}$ they goof off*$]\!]$
$\Leftrightarrow \neg\exists x[\exists w \in [\![goof\ off]\!](x) \cap D_s[x \text{ succeeds in } w]]$
(Any matrix EXH attached to (23b) is vacuous)

What about cases where the bare conditional is in the scope of a universal quantifier, such as (24a)? To derive the right result for these, we must assume that the recursive EXH is embedded under the universal quantifier, (24b). The resulting semantics is in (24c), which is essentially just the embedding of (21) under *everyone*.[14]

(24) a. Everyone will succeed if they work hard [=(1b)]
b. Everyone λx [EXH [EXH [x will succeed if$_{D_s}$ x works hard]]].
c. $[\![$*(24b)*$]\!] \Leftrightarrow \forall x[\forall w \in [\![work\ hard]\!](x) \cap D_s[x \text{ succeeds in } w]]$

For now the assumption of local exhaustification under *every* is admittedly a stipulation.[15] However, the same stipulation is needed to account for Free Choice disjunction embedded under universal quantification as in (8b), given Fox (2007)'s analysis (see Chemla 2009; Singh et al. 2016).

4.3. VP ellipsis resolution and non-monotonic contexts

We saw in section 2 that a lexical ambiguity theory along the lines of Herburger (2015b) runs into problems in the face of the behavior of conditionals in VP ellipsis constructions and in non-monotonic contexts. Regarding the VP-ellipsis data, recall that the problem was how to predict that in a case like (25) the conditional in the antecedent contributes universal semantics, and the one in the elided VP existential semantics. On our proposal, the LF of (25) is in (26).

b. He didn't talk to Mary OR Sue. He talked to both.

The general dispreference of embedded implicatures is taken by many to result from a violable (pragmatic) principle that prohibits implicatures from weakening the global meaning of the sentence. We thus take such a principle to be responsible for the general inavailabililty of $\neg\forall$ intepretations of negated bare conditionals.

Herburger (2015a) argues that universal bare conditionals in DE contexts do exist, based on examples such as (ii).

(ii) a. It is not true that if a fair coin is flipped it will come up heads.
b. If a fair coin is flipped it will NOT come up heads.

We take the fact that such readings, if they exist, are only available with what is arguably "meta-linguistic negation" as in (iia) or special intonation as in (iib) to parallel the facts in (i) and thus to be in line with our approach.

[14] And here too, just like in (21), we ignore the SDAs that yield contradictory propositions, see footnote 9. That is, for each individual x quantified over by *everyone*, the SDAs that end up being entailed by the recursive EXH in (24b) are only those for which $D'_s \cap [\![p]\!](x) \neq \varnothing$.

[15] This stipulation can be dispensed with if we use the exhaustification mechanism proposed by Bar-Lev and Fox (in prep.), who provide an analysis of the embedded Free Choice inference of (8b) that doesn't rely on embedded exhaustification, and instead uses only matrix EXH. In this paper we preferred to use the more familiar mechanism of recursive exhaustification from Fox (2007) over Bar-Lev and Fox's solely due to the unfamiliarity of the latter.

(25) Every boy calls his mother if he gets an A, and no girl does. ≈ [=(6)]
a. For every boy x, in **all** cases where x gets an A, x calls x's mother, and
b. there is no girl x s.t. **there is** a case where x gets an A and x calls x's mother.

(26) Every boy λx EXH EXH [$_{VP}$ x calls x's mother if$_{D_s}$ x gets A], and
(EXH) no girl does λx ~~[$_{VP}$ x calls x's mother if$_{D_s}$ x gets A]~~.

(26) produces the desired quantificational split between the antecedent and the elided VP, and at the same time both are LF-identical.[16] The crucial assumption is that the EXH operators can be outside the VPs, which allows the two VPs to be semantically identical even though we ultimately derive a different quantificational force for each bare conditional. This is similar to the way that generally EXH operates in VP ellipsis constructions. For example, in (27a) the antecedent VP contains *some* which is intuitively interpreted exhaustively as *some but not all*, while in the elided VP *some* is interpreted non-exhaustively under negation (see Fox 2004 for a similar data point, attributed to Tamina Stephenson, p.c.). This is explained if the representation of (27a) is (27b).

(27) a. John solved some of the problems and Mary didn't.
b. EXH John [$_{VP}$ solved some of the problems], and
(EXH) Mary didn't ~~[$_{VP}$ solve some of the problems]~~.

The proper analysis of the non-monotonic example in (7) within our framework requires some elaboration which for space limitations we cannot provide here. However, given the close analogy between (7) and the FC disjunction example (10) discussed in section 3, and given that we proposed that FC disjunction and bare conditionals share an underlying mechanism, the facts in (7) will fall out from an exhaustification-based analysis of (10). Under an ambiguity theory, on the other hand, it is not clear how the facts in (7) can be explained, given the way ambiguities usually behave.

4.4. The structure of alternatives in bare vs. non-bare conditionals

For the derivation of universality in (22) to be successful, it was crucial that the bare conditional didn't have a universal alternative (which amounts to $\mathbf{a} \wedge \mathbf{b}$ in our toy model above), as schematized in (28). Had it been present, EXH would have negated it, and we would have achieved the opposite of what our goal is.

[16] We are aware that the representation in (26) is problematic in light of established constraints on binding in parallelism contexts. Specifically, (26) does not respect the standard requirement that the binder of any elided bound variable be inside the parallelism domain for ellipsis (e.g. Heim 1996; Hartman 2011. See Crnič 2015 for arguments showing that EXH enters into parallelism considerations). We aim to avoid this obstacle in future work by using a mechanism that can derive universal Free Choice globally and assuming the representation in (i) (see footnote 15).
(i) [EXH Every boy [$_{VP}$ λx x calls x's mother if$_{D_s}$ x gets A], and
(EXH) no girl does ~~[$_{VP}$ λx x calls x's mother if$_{D_s}$ x gets A]~~]
We thank Luka Crnič for bringing up this issue.

(28) $Alt((1a)) = Alt(\mathbf{a} \vee \mathbf{b}) = \{\mathbf{a} \vee \mathbf{b}, \mathbf{a}, \mathbf{b} \cancel{, \mathbf{a} \wedge \mathbf{b}}\}.$ (cf. (22b))

We justify the assumption that bare conditionals don't have the universal meaning as an alternative by the fact they don't seem to have a lexical scalar alternative at all. In this we follow other analyses that make use of the lack of a strong alternative for strengthening a weak element. See a.o. Meyer (2016); Bar-Lev and Margulis (2014); Bowler (2014); Singh et al. (2016); Oikonomou (2016). Moreover, potential stronger alternatives like *if p, must q* would involve adding lexical material to the prejacent, an operation which is ruled out by structural (complexity-based) approaches to alternatives, see Katzir (2007); Fox and Katzir (2011).

This perspective has interesting consequences when we consider *non*-bare conditionals (i.e., conditionals with an overt quantificational element, exemplified in (29)): it allows us to capture the semantic difference between bare and non-bare conditionals solely based on the kinds of alternatives they generate. We assume along with the Kratzerian tradition (Kratzer 1986) that the quantification in non-bare conditionals is contributed by the overt quantifier (and there is no additional layer of quantification).

(29) a. If you work hard you **sometimes** succeed.
b. If you work hard you **always** succeed.

Of course, (29a) is not interpreted universally like (29b), and moreover it gives rise to the inference that (29b) is false. We capture this by the fact that crucially, and differently from bare conditionals, the overt quantifier in a non-bare conditional can be replaced with a stronger/weaker quantifier without making the structure more complex. Namely, (29a) has (29b) as an alternative. Given our toy model from above, this feature of non-bare conditionals amounts to admitting $\mathbf{a} \wedge \mathbf{b}$ into the set of alternatives of (29a), in contrast to bare conditionals:

(30) $Alt((29a)) = Alt(\underbrace{\mathbf{a} \vee \mathbf{b}}_{(29a)}) = \{\mathbf{a} \vee \mathbf{b}, \mathbf{a}, \mathbf{b}, \underbrace{\mathbf{a} \wedge \mathbf{b}}_{(29b)}\}$

Thus, only bare conditionals undergo strengthening into a universal meaning, due to the absence of a universal alternative; non-bare existential conditionals cannot undergo such strengthening, since they generate a universal alternative which blocks this derivation. We return to non-bare conditionals in the context of Conditional Perfection in section 5.4.

5. *Only if* and Conditional Perfection

In section 2 we presented data from VP ellipsis (6) and non-monotonic contexts (7) showing that when one occurrence of a bare conditional is involved in some way in both UE and DE contexts, the meaning it contributes splits: universality for the UE context, and existentiality for the DE context. In this section we provide one more piece of evidence showing the same behavior, from Conditional Perfection. Furthermore, we argue that Conditional Perfection data provides additional support to the conjecture that bare conditionals are underlyingly existential. Before we get to that, however, we have to take a small detour and discuss the analysis of *only if* sentences.

5.1. *Only if*

Only if sentences as in (31) have been argued to show another instance of a bare conditional interpreted existentially (see von Fintel 1997; Herburger 2015a). Since *only* is standardly assumed to presuppose its prejacent and assert the negation of its alternatives, the prejacent is in a Strawson-DE environment (von Fintel 1999). The existential interpretation is then expected given the generalization stated in section 1 upon which Higginbotham's puzzle is based.

(31) Only if you work hard you succeed.

What are the compositional details of (31) that produce the correct result? Since *only* takes a prejacent and a set of alternatives, we have to decide what alternatives are in this set. For simplicity, let us follow von Fintel (1997)'s assumption, according to which the alternative that's negated by *only* in a sentence of the form *only if p, q* is *if not-p, q*.[17] In our case, the relevant alternative for the prejacent of *only* in (31) would be *If you don't work hard you succeed*. The interpretation of (31) can then be paraphrased as in (32). The important observation here is that to get the right result for the assertive component, the alternative conditional that *only* negates cannot contribute a universal meaning, but must contribute an existential meaning; otherwise we would only derive the too-weak meaning in (32bii), which is compatible with there being cases where you don't work hard and succeed.

(32) Only if you work hard you succeed. [=(31)]
  a. **Presupposition**: If you work hard you succeed. (See fn. 18)
  b. **Assertion**: $\neg$ if you don't work hard you succeed.
    (i) $\approx \neg$ **there is** a case where you don't work hard and you succeed.
    (ii) $\not\approx \neg$ in **all** cases where you don't work hard you succeed.

Herburger shows that the case of *only if* is predicted by the ambiguity analysis: since *only* creates a Strawson-DE environment, the prejacent *if p, q* is interpreted existentially. According to her, this correctly captures the presupposition triggered by *only if* sentences.[18] Crucially,

[17] Instead of having *if not p, q* as the alternative, a more plausible assumption from the perspective of the theory of alternative formation (Katzir 2007) is that we have a set of alternatives of the form *if r, q*, where *r* is a relevant alternative to *p*. The two options ultimately boil down to the same thing (for reasons we can't go over here), so for ease of exposition we work with the single alternative *if not-p, q*. We thank Andreas Haida for pointing this out.

[18] Our main focus here is capturing the assertive component of *only if*, and we take no stance on whether the presupposed prejacent of *only* should indeed be existential. Herburger argues that it should be existential based on contrasts like (i). Famously, whereas (ia) is non-contradictory, (ib) is not (von Fintel 1997):
(i) a. Only if you work hard do you succeed, and even if you work hard you might fail.
  b. #If you work hard you succeed, and even if you work hard you might fail.
However, we do not know whether this is a strong argument in favor of the existentiality of the prejacent, since *only* independently gives rise to presuppositions that are weaker than its prejacent, as the felicity of (ii) shows:
(ii) Only John$_F$ can speak French, and maybe not even he can. (Ippolito 2008: ex. 37)
Furthermore, in some environments *only* does seem to presuppose its prejacent (for ill-understood reasons), e.g., under negation (as can be seen in (iiia)). And accordingly, when embedding *only if p, q* under negation, it is also much harder to cancel the universal inference that *if p, q*. Compare (ia) with (iiib):
(iii) a. #Not only John$_F$ can speak French, and maybe he can't. (Ippolito 2008: ex. 38)
  b. #Not only if you work hard do you succeed, and if you work hard you might fail.
For these considerations, we do not rely on the presupposition of (31) to determine the quantificational force of

since the prejacent *if p, q* is existential, the alternative *if not-p, q* which is derived from it is interpreted existentially as well.

Note, however, that for Herburger the existentiality of the alternatives only follows from the assumption that the prejacent is existential. This point will be crucial in the following discussion of Conditional Perfection inferences, where the prejacent is unarguably interpreted universally, but the alternatives are still interpreted existentially.

5.2. Conditional Perfection (CoP)

When an *if p, q* sentence is uttered, we often understand it as the 'perfected' conditional *if and only if p, q*. For example, utterance of *if you work hard you succeed* (=(1a)) "invites the inference" (as Geis and Zwicky 1971 put it) that *only if you work hard you succeed* (=(31)). The Conditional Perfection (CoP) inference is cancellable, (33a), and it disappears under negation, (33b). Therefore, it is widely accepted that CoP should be analyzed as an implicature (Geis and Zwicky 1971; von Fintel 2001, a.o.).

(33) a. If you work hard you succeed, and you might succeed even if you don't.
b. No one will succeed if they goof off. [=(1c)]
$\not\approx$ No one will succeed if *and only if* they goof off

The existence of CoP raises a theoretical difficulty for previous analyses of conditionals, given standard theories of implicature calculation. The challenge, as can be seen by the descriptive characterization of CoP in (34), is to derive an existential meaning at the level of the implicature, while retaining universality for the assertion. One can already see that the issue here is very similar to what we have seen with ellipsis and non-monotonic contexts in section 2: in all three cases, from one occurrence of a bare conditional we want to derive different quantificational forces for different ingredients of the overall meaning.

(34) If you work hard you succeed. [=(1a)]
a. **Assertion**: In **all** cases where you work hard, you succeed.
b. **Implicature**: ¬ **there is** a case where you don't work hard and you succeed.

To appreciate the problem, assume (i) that the prejacent *if p, q* triggers the alternative *if not p, q*, (ii) that this alternative is derived from *if p, q* by replacing *p* with *not p*, and (iii) that this alternative is (optionally) negated, supposedly giving us the inference *only if p, q*. Hence: If the prejacent *if p, q* has universal meaning, then *if not p, q* also has universal meaning. Namely, we should expect the implicature to be the negation of a universal meaning, contrary to fact.

It is not straightforward to achieve the right results for CoP in analyses that posit a uniform universal semantics for bare conditionals.[19] Even under an ambiguity analysis, it is not clear

a bare conditional under *only*. The relation between this kind of data and FC disjunction embedded under *only* (see Alxatib 2014) calls for further investigation given our view. We thank Danny Fox and Sam Alxatib for very helpful discussions on this issue.

[19] See for instance von Fintel (2001)'s analysis, in which CoP is derived when *if p, q* has alternatives of the form

why the alternative *if not p, q* is interpreted existentially: Unlike the case of *only if* sentences, in CoP the prejacent is definitely not interpreted existentially, but rather universally as can be seen in (34a). The alternative *if not p, q*, which is generated on the basis of the prejacent, is then also expected to be interpreted universally, contrary to fact.[20]

5.3. Deriving Conditional Perfection

The assumption that bare conditionals are existential provides a simple account of CoP. We assume that *if not p, q* is an additional (and optional) alternative to *if p, q* (but see footnote 17). Namely, (34) has the alternative in (35). Being a bare conditional, its basic meaning is existential, (35a). Negating this meaning would then yield the desired CoP inference in (34b).

(35) If you don't work hard you succeed.
a. $[\![\textit{If}_{D_s} \textit{ you don't work hard you succeed}]\!] = 1$ *iff*
$\exists w \in [\![\textit{You don't work hard}]\!] \cap D_s[\text{you succeed in } w]$

Let us show the derivation in some more detail, illustrating with our toy model from (16) in which $[\![\textit{You work hard}]\!] = \{h_1, h_2\}$ and $[\![\textit{You don't work hard}]\!] = \{nh_1, nh_2\}$. The alternatives we generate for (34) when we add (35) are listed in (36). (36a) repeats from (18) the by-now familiar SDAs of (34). (36b) is the meaning of the new alternative (35) given our toy model. This alternative is logically independent from the prejacent in (36a-i) and the other SDAs in (36a-ii,iii), since its domain of quantification is disjoint from theirs, and we can thus name it **c**. The resulting set of alternatives, which we call C^+, is in (36c).

(36) a. **Sub-Domain Alternatives of (34)** (see (18))
(i) $\exists w \in \{h_1, h_2\}[\text{you succeed in } w]$ (= (17a)) $\mathbf{a} \vee \mathbf{b}$
(ii) $\exists w \in \{h_1\}[\text{you succeed in } w]$ = You succeed in h_1 **a**
(iii) $\exists w \in \{h_2\}[\text{you succeed in } w]$ = You succeed in h_2 **b**
b. ***If not p, q* alternative of (34)**
$\exists w \in \{nh_1, nh_2\}[\text{you succeed in } w]$ = You succeed in nh_1 $\vee$ You succeed in nh_2 **c**

if r, q where *r* denotes any proposition, and importantly propositions that pick out a singleton set of worlds. This essentially reduces universal quantification to existential quantification. On the cost of such reduction see footnote 22.

[20]Herburger (2015b) adopts a non-standard way of implicature calculation to get the right result within her ambiguity approach. For her, an implicature for a sentence *S* is derived by adjoining to *S* a covert ~~*and only S*~~. Effectively, the result is that the prejacent and its alternatives are in environments of different monotonicity. Thus CoP is derived with the structure *if p, q* ~~*and only if p, q*~~, where there are two occurrences of *if p, q*: the overt one is in a UE environment, hence we get a universal prejacent, and the covert one is in a DE environment, hence we get existential alternatives.

This kind of analysis faces some problems. First, recall our argument against ambiguity from ellipsis (section 2), which was based on the fact that ambiguities cannot be interpreted differently in the antecedent material and the elided material. However, Herburger's analysis of CoP essentially relies on an ellipsis construction, and on the idea that the overt *if p, q* can be interpreted universally while the elided *if p, q* is interpreted existentially. Thus our argument from ellipsis extends to her treatment of CoP. Second, it is not clear to us what motivation there is for such an analysis of implicatures other than the CoP data. Third, since the CoP data mirrors the chameleonic behavior of bare conditionals in ellipsis constructions and in non-monotonic contexts, for which such an analysis is not available, a principled analysis for all of these cases is called for.

c. **Enriched set of alternatives of (34)**
$C^{+} = \{\mathbf{a} \vee \mathbf{b}, \mathbf{a}, \mathbf{b}, \mathbf{c}\}$

Given C^{+}, the result of recursive EXH is in (37). The *if not p, q* alternative **c** is negated by the lower EXH without affecting the workings of the higher EXH. Namely, adding the *if not p, q* alternative to the set of alternatives of *if p, q* does not interfere with the generation of universality for the latter, essentially because their domains of quantification are disjoint.

(37) $$[\![\text{EXH}_{C^{+\prime}}\ \text{EXH}_{C^{+}}\ \textit{if}_{D_s}\ \textit{you work hard you succeed}]\!] = 1 \textit{ iff}$$
$$\underbrace{\forall w \in \{h_1, h_2\}[\text{you succeed in } w]}_{\text{Universal strengthening (matrix EXH) } (\approx\text{(34a)})} \wedge \underbrace{\neg\exists w \in \{nh_1, nh_2\}[\text{you succeed in } w]}_{\text{CoP inference (embedded EXH) } (\approx\text{(34b)})}$$

In sum, the fact that bare conditionals give rise to a universal meaning in their assertion and an existential meaning in their implicature is predicted under our analysis.

5.4. Conditional Perfection with non-bare conditionals as evidence for an existential semantics for bare conditionals

In section 2 we have presented arguments against an ambiguity analysis of bare conditionals, and in section 3 we proposed a unified existential semantics based on the analogy with FC disjunction. In the previous section we have shown that the existential semantics assumption correctly predicts the CoP inferences of bare conditionals with no further complications. In what follows we present another motivation for the assumption that the basic semantics of bare conditionals is existential, coming from the behavior of CoP with *non*-bare conditionals.

A fact that (to our knowledge) has been largely unnoticed is that the behavior of non-bare conditionals is different from that of bare conditionals with respect to CoP. As Herburger (2015b) observes, when the conditional contains an overt universal adverb that the *if*-clause restricts, as in (38), we get a weaker CoP implicature than with bare conditionals, namely (38a) rather than (38b).[21] This difference between (38a) and the CoP inference of bare conditionals in (34b) is already surprising if we assume that bare conditionals are universals.[22]

(38) If you work hard, you **always** succeed.
a. $\rightsquigarrow$ **Weak CoP**: if you don't work hard, you don't **always** succeed.
b. $\not\rightsquigarrow$ **Strong CoP**: if you don't work hard, you don't succeed.

Even more striking is the fact that existential non-bare conditionals like (39) give rise to strong

[21] An issue that arises is why (38) doesn't have (i) as an alternative, the negation of which would produce the unattested strong CoP in (38b).
(i) If you don't work hard, you **sometimes** succeed.
A possible way to avoid it is to assume a non-weakening constraint on the generation of alternatives, as suggested in Fox (2007: fn. 35) (see also Romoli 2012; Trinh and Haida 2015), such that (i) would not be generated.

[22] Under von Fintel (2001)'s analysis of CoP (see footnote 19), for instance, there is no apparent reason why non-bare universal conditionals should not generate alternatives where the antecedent picks out singleton sets of worlds, while this option would be available for bare conditionals.

CoP, in (39a), just like bare conditionals do.

(39) If you work hard, you **sometimes** succeed.
  a. $\rightsquigarrow$ **Strong CoP**: if you don't work hard, you don't succeed.

We take this pattern as further evidence that the basic semantics of bare conditionals should be existential, in light of their resemblance to existential rather than universal non-bare conditionals in terms of the kind of implicatures they give rise to. Admittedly, this is indirect evidence. However, as we have seen the chameleonic behavior of bare conditionals leaves little room for direct evidence.

6. Concluding remarks

Higginbotham's puzzle casts doubts on views according to which bare conditionals are uniformly interpreted universally. We have shown however that a simple ambiguity theory such as Herburger's is also questionable given the behavior of bare conditionals in VP ellipsis constructions and in non-monotonic contexts, as well as Conditional Perfection data. We argued for a unified existential semantics for bare conditionals, based on (i) the similarity in distribution between their quantificational force and the availability of Free Choice inferences for disjunction under an existential modal, and (ii) the fact that their Conditional Perfection inferences pattern with those of existential non-bare conditionals rather than universal ones.

Following the analogy with FC disjunction, we proposed an analysis that derives the universality of bare conditionals in UE contexts using the same mechanism of grammatical strengthening utilized by Fox (2007) to derive FC inferences. The crucial assumptions for this derivation to go through are (i) that bare conditionals give rise to sub-domain alternatives which are obligatorily exhaustified (as in Chierchia 2013's analysis of NPIs), and (ii) that bare conditionals don't have a universal alternative.

One might wonder about the seemingly stipulative nature of assuming obligatory sub-domain alternatives for bare conditionals. We have no direct evidence for this assumption, and it is currently justified only in so far as it (together with independently suggested mechanisms) predicts the correct pattern of behavior. However, an interesting line of research worth pursuing is that sub-domain alternatives are generated for the restrictor of *every* quantificational operator, but their effect is mainly noticeable when there is no scalar alternative (see section 4.4). If this is developed successfully, then the assumption that bare conditionals give rise to sub-domain alternatives would be just a special case of this hypothesis.[23]

The analysis presented here opens up a new line of investigation into the research of homogeneity phenomena in general, of which Higginbotham's puzzle is arguably only one manifestation. A notable case in point is definite plurals: it has been suggested by Magri (2014), following

[23]The assumption that these alternatives are *obligatorily* exhaustified requires further justification, which we are unable to provide yet. A promising direction, though, is to relate it to Singh et al. (2016)'s independently motivated proposal that applying EXH is highly preferred when it provides the complete answer to the Question Under Discussion. Note that the universal meaning we derive for (1a) by applying EXH provides the complete answer to the question *under what circumstances do you succeed?*, while the basic existential meaning doesn't.

Spector (2007), that definite plurals bear existential semantics which is strengthened in UE environments, on similar lines to what we propose. Independently, Schein (2003) and Schlenker (2004) have suggested an analysis of conditionals as definite plurals. Brought together, these approaches may lead to a new perspective on homogeneity phenomena. In future work we hope to compare this perspective with other approaches, most notably Križ (2015).

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Towards a model of incremental composition[1]

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Abstract. This paper reviews some recent psycholinguistic results on semantic processing and explores their consequences for a cognitively plausible model of incremental composition. We argue that semantic composition is neither strictly incremental (in the sense that every incoming word is composed immediately) nor global (in the sense that composition only proceeds when the entire syntactic structure is available). We conjecture that incremental composition is type driven: elements in the same type domain (e.g. temporal <i>) are composed immediately; elements that concern different type domains (e.g. temporal <i> vs. event <v>) cause delayed processing.

Keywords: Incrementality, composition, semantic processing.

1. Introduction

The central question explored in this paper is how a theory of semantic composition can be combined with processing results arguing that interpretation has incremental properties. Semantic theory takes as its starting point the principle of compositionality: The interpretation of a complex expression is determined by the interpretations of its parts and the way they are combined. This is usually implemented in terms of assigning a compositional interpretation to the **complete** syntactic representation of the sentence to be interpreted (see standard introductions, e.g. Heim and Kratzer, 1998; Chierchia and McConnel-Ginet, 2000; Zimmermann and Sternefeld, 2014; Beck and Gergel, 2014). However, certain results from psycholinguistic research fairly clearly show that people begin to compose meanings **before** the end of the sentence has been perceived, so no complete tree is available. A suggestive data point is the familiar garden path effect (Bever, 1970), illustrated in (1) (Ferreira, Christianson and Hollingsworth, 2001).

(1) While Anna dressed the baby spit up on the bed.

So far, neither compositional semantics nor psycholinguistics has established a psycholinguistically plausible model of how compositional interpretation proceeds incrementally (cf. also e.g. Chater et al., 2001; Bott and Sternefeld, to appear). This is a problematic gap in linguistic theory because results on semantic processing don't get integrated into a theory of the semantic parser or aligned with the theory of composition. This paper is a contribution towards closing this gap. Our plot is to use a standard semantic framework (concretely a Heim and Kratzer, 1998, type theory) as our starting point, and revise it according to a set of concrete processing results we take to be exemplary, as a step towards a model of incremental composition.

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Section 2 defines our task and outlines some relevant existing work in semantics and in psycholinguistics. In section 3, we present the evidence for incremental composition from a set of processing studies and an incremental analysis of those data points. Section 4 combines the results of section 3 and generalizes towards a model of incremental interpretation. Our conclusions are presented in section 5.

2. Specifying the task

2.1. What is needed?

Standard semantic theory defines an interpretation function [[.]] recursively. [[.]] maps LF trees to meanings (e.g. Heim and Kratzer, 1998). Compositional interpretation proceeds as sketched in (3) for a simple example. We call this **global interpretation**.

(2) T -- [[]] --> $\cup D\tau$ (τ a semantic type)

(3) a. John invited Bill.
b. structure: $[_{IP}$ John $[_{VP}$ invited Bill]]
c. [[$[_{IP}$ John $[_{VP}$ invited Bill]]]] = 1 iff (2x Function Application FA)
[[invited]] ([[Bill]]) ([[John]]) = 1 iff (Lexicon + λ-conversion)
John invited Bill.

What if we start interpreting on the basis of a partial structure (4a)? Plausibly we anticipate (4c). A theory that can predict (4c) requires the concepts defined in (5), (6) and (7).

(4) a. partial structure: $[_{IP}$ John $[_{VP}$ invited …
b. from the lexicon: {[[John]], [[invited]]}
c. projected meaning: λy. [[invited]](y)([[John]]) =
λy. John invited y

(5) a. Let Θ be the set of syntactic structures produced by the human parser.
Each $T_i \in \Theta$ is a possibly partial syntax tree.
b. Let Σ be the set of interpretations produced by the corresponding human interpretive processor. The elements of Σ are sets of meanings, i.e. each $S_i \in \Sigma$ is a set whose members are elements of $\cup D\tau$ (τ a semantic type).
c. A pair $<T_i, S_i>$ is a stage reached in sentence processing.

(6) Incremental processing is a series of mappings $<T_i,S_i> \rightarrow <T_{i+1},S_{i+1}>$ ($1 \leq i \leq n$) such that
(i) T_n is an LF tree;
(ii) each mapping $T_i \rightarrow T_{i+1}$ is a matter of parsing (not our concern here);
(iii) each S_i is a set of meanings from $\cup D\tau$;
(iv) card(S_n)=1 (i.e. everything is composed into one meaning in the end);
(v) $<T_n,S_n> \in$[[.]].

(7) Incremental composition is the derivation of S_{i+1} from S_i.
Define a function $[[.]]_h$ ('heuristic interpretation'):
Suppose at stage i, the processor receives the structure σ as input, leading to T_{i+1}.
$[[.]]_h$ defines a mapping $<T_{i+1}, S_i, [[\sigma]]_h > \rightarrow S_{i+1}$.
On the basis of the new tree, the available set of meanings plus the new meaning, a new semantic stage is reached.

We can think of the function $[[.]]_h$ as an interpretive heuristic. It makes predictions about the meaning of partial trees, yielding a projected or anticipated meaning (which could be proven wrong by further input). A model of incremental composition is a recursive definition of the function $[[.]]_h$. For each stage that the parser may reach, $[[.]]_h$ defines the accompanying stage of the interpreter.

2.2. What has been proposed in semantics?

Several linguistic frameworks have made proposals towards incremental interpretation, prominently including the categorial grammar tradition. A representative is Combinatory Categorial Grammar CCG (e.g. Ades and Steedman, 1982; Steedman, 2000; Steedman and Baldridge, 2011) and a simple example is given below. The syntax of CCG allows the incremental parse in (8b) — we are still looking for an NP to complete the sentence — and the semantics corresponds to this, employing Function Composition (9) to compose the meaning of the subject and the meaning of the verb as in (8d).

(8) a. John invited Bill.

b.	basic syntax:	John	invited	Bill
		S/(S\NP)	(S\NP)/NP	NP
			S\NP	
c.	incremental parse:	John	invited	
		S/(S\NP)	(S\NP)/NP	
			S/NP	

d. semantics:
$[[\text{John}]] = \lambda P_{<e,t>}.P(\text{John})$
$[[\text{invited}]] = \lambda y.\lambda z.z \text{ invited } y$
$[[\text{John}]]\bullet[[\text{invited}]] = [\lambda P_{<e,t>}.P(\text{John})]\bullet[\lambda y.\lambda z.z \text{ invited } y]$
$= \lambda x. [\lambda P_{<e,t>}.P(\text{John})]([\lambda y.\lambda z.z \text{ invited } y](x))$
$= \lambda x. \text{ John invited } x$

(9) Function composition:
If g is a function: A->B and f is a function: B->C then
$f\bullet g$: A->C is the composition of f and g with $f\bullet g=\lambda x.f(g(x))$

The example illustrates what we call **strict incrementality**. Each new element that is parsed is added immediately to the tree and composed immediately with the semantics already available. At each stage i, $card(S_i)=1$. In section 3, we will reject strict incrementality as a property of the semantic processor. There is a tendency in the CCG tradition towards strict incrementality (recently e.g. Kato and Matsubara, 2015), though details vary and Steedman's

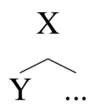
(2000) Strict Competence Hypothesis SCH does not lead one to always expect strict word-by-word incrementality (see e.g. Demberg, 2012; Ambati, 2016 for discussion).

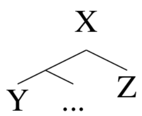
Outside CCG, our most immediate predecessor in the search of a model of incremental composition is Bott and Sternefeld (to appear). Bott and Sternefeld differ from us in two important respects: (i) they aim for strict incrementality, and (ii) they use a different framework (namely a dynamic Neo-Davidsonian continuation semantics with unconstrained λ-conversion), which we will not present here. But they point out the same gap in linguistic theory (cf. their paper also for further references), they consult an overlapping set of psycholinguistic results to inform their model of incremental composition, and they develop an incremental perspective on complex semantic analyses e.g. of tense and aspect. We return to their paper below.

2.3. What has been done in processing?

First, a cautionary note: We want to know when **composition** of meanings in complex structures occurs; not all results to do with immediate semantic processing are therefore of relevance for us (e.g., a finding could be based on immediate lexical access but not immediate composition; see e.g. Altmann and Kamide, 1999; or Frazier, 1999 for an overview). In recent years, psycholinguistic research on semantics has produced a lot of results on how different phenomena are processed (e.g. quantifiers, presuppositions etc. - a recent overview is given in Pylkkänen and McElree, 2006). The findings indicate particular properties of semantic processing and define certain constraints on it. What has not been established is a semantic processing model in the sense of heuristic composition $[[.]]_h$, i.e. there is no model that we know of (with the exception of Bott and Sternefeld) which describes how actual incremental composition works.

There is of course more work on syntactic processing, and this is important as the input to compositional interpretation (see e.g. discussion in Crocker, 2010). Resnik (1992), building on earlier work, argues for an *arc-eager* left corner parser, i.e. a variant of a left corner parser in which nodes that are predicted bottom-up can be immediately composed with nodes that are predicted top-down. We assume that the syntactic processor continuously integrates new material in a roughly left corner parser fashion. At any point during processing, a partial tree structure like (10) is projected by the syntactic parser. In this paper we simplify in that only one parse tree will be entertained as a possible structure at a time. (Ideally, we would adopt whatever proposal about the parser is best motivated.) Importantly, the tree T_i is the LF structure (the input to compositional interpretation). The terminal nodes in T_i include the words heard so far (in their proper places in the structure). The tree is the projected syntax.

(10) a.


b.


Another input to compositional interpretation is lexical meaning. There is evidence that the interpretation of lexical terminal nodes is available immediately from the lexicon (e.g. Frazier and Rayner, 1990). Hence we assume that these meanings are added to S_i (the set of meanings made available by the parse so far). And finally, compositional interpretation depends on the values assigned to variables. Free variables get their value from the context via the salient variable assignment function g_c. When all goes well, they are assigned their values immediately (e.g. Carreiras and Clifton, 1993). The resulting meanings are also added to S_i. When there is no salient referent, binding of the variable is preferred; this may lead to a revision of the LF tree in such a way as to include a binder, or to optimize the chances of including a binder (that is, it can lead to delayed semantic interpretation, see section 3.2.; Bott and Schlotterbeck,2013).

The anticipated lexical meaning and anticipated contextual reference are the recursion basis for the function $[[.]]_h$: If α is a terminal element, $[[\alpha]]_h=[[\alpha]]$.

As an **interim summary**, we note that two interpretive strategies (11), (12) are made readily available by existing theories of interpretation. As a preview of what is to come, we argue that neither type of approach is the desired model of incremental composition. (Of course Global interpretation is not claimed to be a model of the semantic processor in the first place).

(11) **Global interpretation**:
Assume a syntactically **complete** parse tree T (i.e. no "…").
The meanings in S (here, the terminal nodes in T) are composed by [[.]]
according to T and the standard composition principles.

(12) **Strictly incremental interpretation**:
Assume an incrementally generated **partial** tree T, and a set of available meanings S.
Whenever card(S)>1, compose the meanings in S according to T and some
combinatory heuristic $[[.]]_h$.

3. Some psycholinguistic findings on incremental composition

In section 3.1. we collect a set of experimental results that argue for immediate composition in certain sentence contexts, and offer an incremental analysis of these cases. In section 3.2. we consider several cases of delayed composition, i.e. experimental evidence that there is no strictly incremental composition. The section summary sets the scene for our generalizations in section 4.

3.1. Results supporting immediate composition

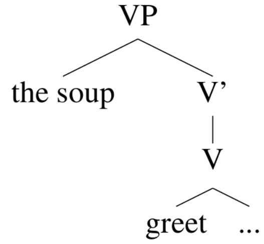
Subject + Verb: There are early effects indicating that before the object is encountered, the meanings of the subject and the verb are already put together (e.g. Kuperberg et al., 2003; Kim and Osterhout, 2005; Kamide et al., 2003; Knoeferle et al., 2005). We take this to mean that subject and verb are interpreted incrementally, before the sentence is finished. (13)

illustrates the relevant structure; # marks the point where studies have found an interpretive effect in processing.

(13) The soup greeted …
|
#

This invites the following interpretation: The parse tree contains (14a); this leads to a combination of the meanings of the verb and the subject as in (14b). (14b) can be derived by the heuristic rule in (15). If we suppose that the subject has the type <<e,t>,t> rather than <e>, the alternative formulation in (16) is applicable. (16) amounts to function composition (17).

(14) a. projected parse tree contains:



b. projected meaning:
$\lambda y.[[\text{greet}]](y)([[\text{the soup}]]) =$
$\lambda y.\text{the soup greet } y$

(15) Subject-Verb-Heuristic (SVH):
If α= [β_{subj} [γ_{verb} …
then $[[\alpha]]_h = \lambda y.[[\gamma_{<e,et>}]]_h(y)([[\ \beta_{<e>}]]_h)$

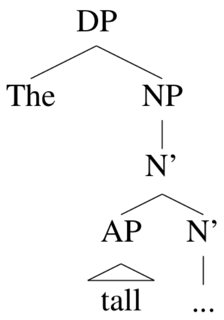
(16) Subject-Verb-Heuristic (<<e,t>,t> subject) (SVH'):
If α= [β_{subj} [γ_{verb} …
then $[[\alpha]]_h = \lambda y.[[\ \beta_{<et,t>}]]_h([[\ \gamma_{<e,et>}]]_h(y))$
SVH' defines $[[\beta]]_h \bullet [[\gamma]]_h$

(17) Function composition:
If g is a function: A->B and f is a function: B->C then
$f \bullet g$: A->C is the composition of f and g with $f \bullet g = \lambda x.f(g(x))$

Within DP: There is evidence that determiner and adjective are combined very early on (Sedivy et al., 1999). (18) illustrates this. Our interpretation is that the meaning of the determiner plus the meaning of the NP is incrementally interpreted as indicated in (19).

(18) Touch the tall …
|
#

(19) a. projected parse tree contains:



b. projected meaning:
λP.[[the]]([[tall]]$\cap$P)

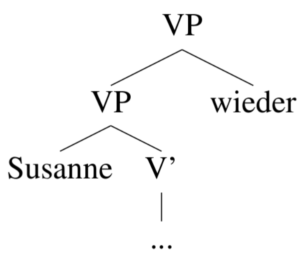
Part of predicting (19b) is the expectation that the meaning of the determiner is applied to a suitable argument, as modelled by the DP-Heuristic below. This heuristic defines predictive Function Application FA.

(20) DP-Heuristic:
If α= [$_{DP}$ β_{Det} [$_{NP}$ γ …
then [[α]]$_h$ = [[β]]$_h$ ([[NP]]$_h$)

Subject + Adverb: Under certain circumstances, people anticipate a complex meaning given the input of a subject plus an adverb, here *wieder* 'again' (Tiemann, 2014; Tiemann et al., 2011). We interpret this as our participants anticipating that the adverb will modify some property attributed to the subject.

(21) a. context: Inge hat letzte Woche rote Handschuhe gekauft.
Inge has last week red gloves bought
b. Susanne hat wieder…
Susanne has again
|
#

(22) a. projected parse tree contains:



b. projected meaning:
$\lambda P_{<e,vt>}$. [[wieder]](λe.P(e)(Susanne)) =
$\lambda P_{<e,vt>}.\lambda e{:}\exists e'[e'<e$ & P(e')(Susanne)].P(e)(Susanne)

This projected meaning can be predicted by the heuristic rule in (23). Once more, if the subject is taken to be of type <<e,t>,t> rather than <e>, the heuristic is rephrased in such a way as to reveal it as function composition (24).

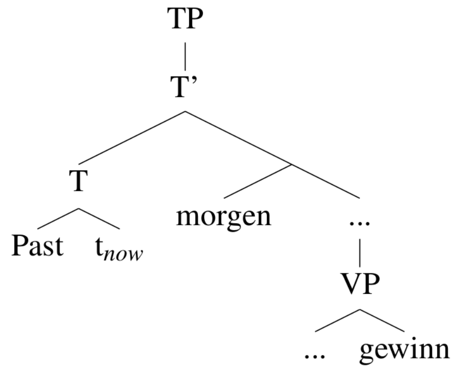
(23) <v,t>-Adverb-Subject Heuristic (AdvSH):
If $\alpha = [[\ \beta_{subj} \ldots]\ \gamma_{adverb}\ ]$ and γ is of type $<vt,vt>$,
then $[[\alpha]]_h = \lambda P_{<e,vt>}.[[\gamma]]_h(P([[\ \beta]]_h))$

(24) <v,t>-Adverb-Subject Heuristic (<<e,t>,t> subject) (AdvSH'):
If $\alpha = [[\ \beta_{subj} \ldots]\ \gamma_{adverb}\ ]$ and γ is of type $<vt,vt>$,
then $[[\alpha]]_h = \lambda P_{<e,vt>}.[[\gamma]]_h([[\ \beta]]_h(P))$
AdvSH' defines $[[\gamma]]_h \bullet [[\beta]]_h$

Temporal Adverb + Tense: Bott (2010) found that participants respond immediately to a mismatch between verbal tense and the meaning of an adverb, as in (25). Our take on what happens in processing is (26).

(25) Morgen gewann…
tomorrow won
|
#

(26) a. projected parse tree contains:



b. projected meaning:
$\lambda P_{<i,t>}.[[\text{PAST } t_{now}]](\lambda t'.t' \subseteq \text{tomorrow} \ \&\ P(t')) =$
$\lambda P_{<i,t>}.\exists t'[t' < t_{now} \ \&\ t' \subseteq \text{tomorrow} \ \&\ P(t')]$

The heuristic predicting this anticipated interpretation and the clash contained in it can be phrased as in (27) (assuming <i,t> type modifiers) or (28) (assuming <<i,t>,<i,t>> modifiers).

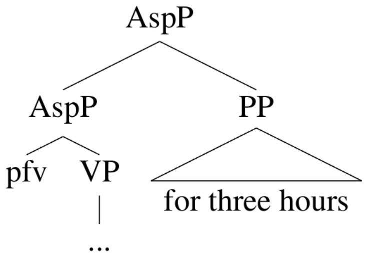
(27) Temporal adverb – Tense Heuristic (intersective modifiers):
If $\alpha = [\beta_{Tense}\ [\ \gamma_{adverb} \ldots]]$ and γ is of type $<it>$,
then $[[\alpha]]_h = \lambda P_{<i,t>}.[[\beta]]_h(\lambda t'[[\gamma]]_h(t') \ \&\ P(t'))$

(28) Temporal adverb – Tense Heuristic (functional modifiers):
If $\alpha = [\beta_{Tense}\ [\ \gamma_{adverb} \ldots]]$ and γ is of type $<it,it>$,
then $[[\alpha]]_h = \lambda P_{<i,t>}.[[\beta]]_h([[\gamma]]_h(P))$
The Temporal adverb–Tense Heuristic (shifted) defines $[[\beta]]_h \bullet [[\gamma]]_h$

Russian Aspect: Bott and Gattnar (to appear) found that in Russian a mismatch of aspect with an adverb (29) was detected immediately, suggesting incremental interpretation. This finding is especially interesting when compared to the processing of German aspect, discussed in the next subsection. The Russian results indicate that the compositional step in (30) is taken immediately:

(29) Celych tri casa vyigrala
Whole three hours win.pfv.Past …
|
#

(30) a. projected parse tree contains:



b. projected meaning:
$\lambda P_{<v,t>}. \exists e[[[pfv]](e) \ \& \ [[for\ three\ hours]](e) \ \& \ P(e)]$

No detailed analysis or heuristic is offered because the details of the analysis for Russian are not sufficiently clear to us (see Bott and Gattnar, to appear; Bott and Sternefeld, to appear, for discussion). It is clear however that there is an immediately perceived clash between the aspect information and the adverbial. Those two expressions must be part of a local tree in the AspP. We conjecture that the example is (abstractly) parallel to the temporal adverb–tense case above.

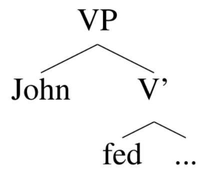
To sum up this subsection, we have identified five circumstances that showcase immediate composition of two semantic units that do not form a constituent in the LF. Note that in each case, the two units occur in the same LF domain (DP, VP, TP, AspP). Their combination may be understood as predicted function application or function composition. (See Bott and Sternefeld, to appear, for a different, but similarly incremental analysis of e.g. the tense and the aspect cases.)

3.2. Results supporting delayed composition

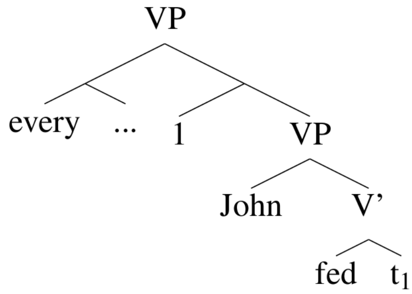
Quantifiers: Hackl et al. (2012) (see also Varoutis and Hackl, 2006; Breakstone et al., 2011; but cf. Gibson et al., 2014) argue that there is evidence for quantifier raising (QR) and delayed interpretation of quantifiers in object position (31). We illustrate our interpretation of this finding in (32): encountering the quantified determiner leads to a revision of the parse tree.

(31) John fed every dog.
|
no composition here.

(32) a. 1st projected parse tree contains:



b. revised parse tree contains:



Note that consequently, it is not the case that the meaning calculated so far — presumably [λy. John fed y] — is combined with the meaning of *every* (yielding e.g. [$\lambda P_{<e,t>}$. for every y such that P(y), John fed y]). Hence this is a case that does not work according to strict incrementality. It seems extremely plausible that recovering from a garden path like (1) also involves such a revision (cf. e.g. Chater et al., 2001), i.e. in addition to throwing out the parse that turned out to be misguided, the corresponding interpretation is thrown out along with it.

German Aspect: Bott (2013) and Bott and Gattnar (to appear) show that aspectual mismatch in German is only processed when the verb has received its full argument structure, suggesting that the meaning of an adverbial ('for two hours') is not immediately combined with the meaning of a verb ('won'). Composition only happens later (in contrast to Russian).

(33)	Zwei Stunden lang	gewann	der Boxer	den Kampf.
	two hours for	won	the boxer	the fight
		|		
		no composition here.		

It seems plausible that the meanings of the available items are added to the set of meanings made available by the processor, but not composed. So this is an instance of delayed composition. In very general terms, the so-called sentence wrap-up effect (Just and Carpenter, 1980) may also be an indication of late processes in semantic composition.

Further candidates: We mention two further candidates that have been presented as indicators for late composition processes. The model in section 4 will not properly include them because they involve semantic issues we can't yet address (variable binding and presupposition projection) but they provide general support of our position. First, Bott and Schlotterbeck (2013) present an eyetracking study investigating the processing of inverse scope as in (34a) vs. (34b) without scope inversion. Their results suggest that scope inversion is only computed at the end of the sentence (this is also the interpretation of this finding in Bott and Sternefeld).

(34) a. Jeden seiner Schüler hat genau ein Lehrer voller Wohlwollen gelobt.
Each of-his pupils has exactly one teacher full-of goodwill praised
'A teacher praised each of his pupils full of goodwill.'
b. Jeden dieser Schüler hat genau ein Lehrer voller Wohlwollen gelobt.
Each of-these pupils has exactly one teacher full-of goodwill praised
'A teacher praised each of these students full of goodwill.'

Second, Schwarz and Tiemann (to appear) conducted experiments on the processing of sentences with unfulfilled embedded and unembedded presuppositions (35a,b). Whilst presupposition failure in the unembedded cases (35b) was immediately detected in online processing, there was no such effect in the embedded conditions. We take this to mean that the composition of embedded presuppositions does not happen strictly incrementally, otherwise presupposition failure should result in immediate processing effects as they do in the unembedded cases.

(35) a. Heute war Tina nicht wieder schlittschuhlaufen.
Today was Tina not again ice-skating
'Today, Tina didn't go ice skating again.'
b. Heute war Tina wieder nicht schlittschuhlaufen.
Today was Tina again not ice-skating
'Today, once more Tina didn't go ice skating.'

In sum, we have evidence that semantic units are not always composed immediately. Predictive combinatory mechanisms do not seem to be explored to exhaustion to calculate a composed meaning under all circumstances. This is why we depart from strict incrementality (as developed e.g. in Bott and Sternefeld).

Interim Conclusion: If the above view is correct, neither global interpretation nor strict incrementality seems to be the right model of semantic processing. Composition in semantic processing has incremental properties, but it also seems to require certain units to be built before composition proceeds. The required model needs to employ what we might call **enlightened incrementality**: sometimes composition is immediate, but under other circumstances it is delayed. What would be a useful hypothesis about when the processor applies which type of strategy? The next subsection addresses this question.

4. First steps towards a general framework

This section generalizes from the concrete incremental compositional analyses in section 3. The desired outcome is (the beginnings of) a framework for theories of semantic parsing: a definition of a function $[[.]]_h$ ('heuristic interpretation') as anticipated in section 2. Naturally, we are far from being able to propose a complete model for this mapping. But we can distill some generalizations from the case studies in section 3. We propose that a realistic semantic processor sometimes composes 'early' and sometimes 'late', depending on the linguistic input. Our evidence indicates the general possibility of four cases: (i) wait and see, (ii) revision of LF, (iii) predictive Function Application (FA), (iv) predictive Function Composition (FC). These are generalizations over the interpretive strategies that section 3 provides evidence for. Subsection 4.1. examines the 'late' strategies, subsection 4.2. the 'early' composition strategies. In subsection 4.3. we develop a hypothesis as to when the semantic processor employs which type of strategy.

4.1. Delayed composition

Beginning with 'late' composition strategies, section 3 provides evidence for (i) wait and see. The example indicative of this strategy is German aspect (and also (34), (35)). Stages of the processor are sketched in (37).

(i) **wait and see**
Given <T,S> and input σ, map to <T',S'>,
where T' is the modification of T derived by the syntactic parser and S' is defined by:
$[[\cdot]]_h$: <T',S,$[[\sigma]]_h$> -> S∪{$[[\sigma]]_h$}

(36) Zwei Stunden lang gewann der Boxer den Kampf.
two hours for won the boxer the fight
|
no composition here.

(37) a. T=[CP [PP zwei Stunden lang] …]]
S={[[for 2h]]}
b. T'=[CP [PP zwei Stunden lang] _ [TP Past …]]]
S'={[[for 2h]], [[Past]]}

The second case of non-incremental interpretation we have seen is (ii) revision of LF. The example for this strategy from section 3 is quantifiers in object position (and also (1)).

(ii) **revision of LF**
Given <T,S> and input σ, map to <T',S'>,
where T' is the revision of T derived by the syntactic parser, and S' is defined by:
$[[\cdot]]_h$: <T', S, $[[\sigma]]_h$> ->{x: x is the meaning of an atom in T}∪$[[\sigma]]_h$>

(38) John fed every dog.
|
no composition here.

At this point we digress a little in order to explain more fully our take on what happens in (38). Revision of the parse tree from T to T' would be compatible with keeping the meanings composed so far and adding the new meaning, according to the (i) wait and see strategy, as sketched in (39). We conjecture, however, that the processor also reconsiders the store of meanings. Our motivation comes from examples that have, in addition, a quantifier in subject position, (40). If the processor kept the meanings composed so far, we would get (41). Continuing processing on this basis would in our framework (i.e. without type shifting or further scope mechanisms) lead to the inverse scope reading (40b). It seems implausible that the processor smoothly generates the intuitively harder reading. It is more plausible that the processing of the doubly quantified example involves the steps in (42) — the composition of subject and verb is thrown out. This motivates our assumption that (ii) is operative in this case.

(39) a. T= [VP John [V' fed …]]
S={[[John fed]]} = {λy. John fed y}
b. T'=[VP [NP every …][1[VP John [V' fed t1]]]
S'= {λy. John fed y, [[every]]}

(40) Some guy fed every dog.
a. ∃x[∀y[dog(y) -> x fed y]] (surface scope)
b. ∀y[dog(y) -> ∃x[x fed y]] (inverse scope)

(41) a. T= [VP [NP some guy] [V' fed …]]
S={[[some guy fed]]} = {λy. ∃x[x fed y]}
b. T'=[VP [NP every …][1 [VP [NP some guy] [V' fed t1]]]]
S'= { [[every]], λy. ∃x[x fed y]}

(42) a. T=[IP _ [I' [VP [NP some guy] [V' fed …]]]]
S={[[some guy fed]]} = {λy. ∃x[x fed y]}
b. T'=[IP [NP some guy] [2[I' [VP [NP every …][1[VP t2 [V' fed t1]]]]
S'= {[[some guy]], [[every]], [[fed]]}

In the (ii) revision of LF case, therefore, the processor performs a revision of the parse tree and throws out a predicted meaning in S as well, reconsidering composition.

4.2. Incremental composition.

Let's next turn to 'early' composition. Section 3 anticipates (iii) predictive Function Application.

(iii) **predictive Function Application (FA)**
Given <T,S> and input σ, map to <T',S'>,
where T' is derived by the syntactic parser and
if there is a δ∈S such that (a) $[[\sigma]]_h(\delta)$ or
(b) $\delta([[\sigma]]_h)$ is defined, then,
(a) $S'=S\backslash\delta \cup \{[[\sigma]]_h(\delta)\}$ or
(b) $S'=S\backslash\delta \cup \{\delta([[\sigma]]_h)\}$ (whichever is defined).

The example from section 3 is immediate compositional interpretation in the DP, (43). Predictive FA would similarly be involved in (44). This proposal could be further tested by data like (45), which we give as a suggestion for future research.

(43) Touch the tall …

(44) a. Every dog…
b. S={[[every]]}, S'={[[every]]([[dog]])}

(45) a. Every dog that greeted its master was fed.
b. Every dog was fed that greeted its master.

The second 'early' composition mechanism from section 3 is (iv) predictive Function Composition (assuming the higher types for the heuristics). Examples from above were the data types in (46).

(iv) **predictive Function Composition (FC)**
Given <T,S> and input σ, map to <T',S'>,
where T' is derived by the syntactic parser and
if there is a $\delta \in S$ such that (a) $\delta \bullet [[\sigma]]_h$ or
(b) $[[\sigma]]_h \bullet \delta$ is defined, then,
(a) $S' = S \backslash \delta \cup \{\delta \bullet [[\sigma]]_h\}$ or
(b) $S' = S \backslash \delta \cup \{[[\sigma]]_h \bullet \delta\}$ (whichever is defined).

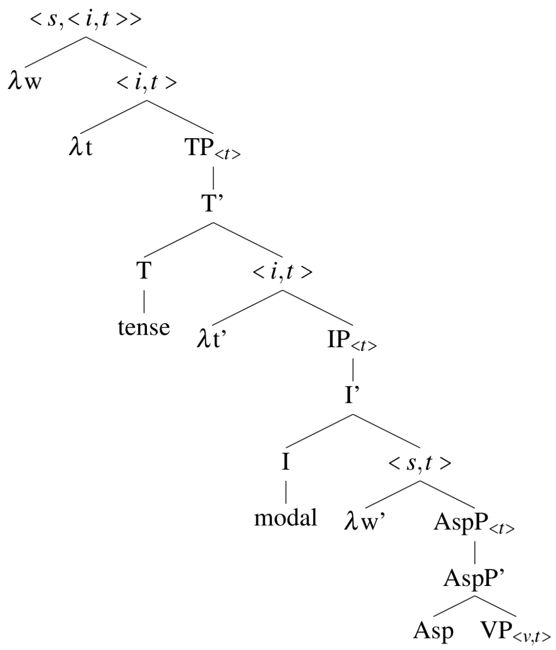
(46) a. The soup greeted… (subject–verb)
b. Morgen gewann… (tense–adverb)
tomorrow won …
c. Susanne hat wieder… (subject–adverb)
Susanne has again …

4.3. When is composition 'early' and when 'delayed' – a possible generalization

A model of semantic processing in the sense of enlightened incrementality should be an optimal compromise regarding two conflicting demands: (a) a low load on working memory: it is unrealistic that we carry around a large number of separate meanings until the end of an utterance; (b) reliable predictions: it is undesirable to randomly compose word meanings when the confidence that this is the actual interpretation is low. We offer the conjecture below for what this compromise could look like.

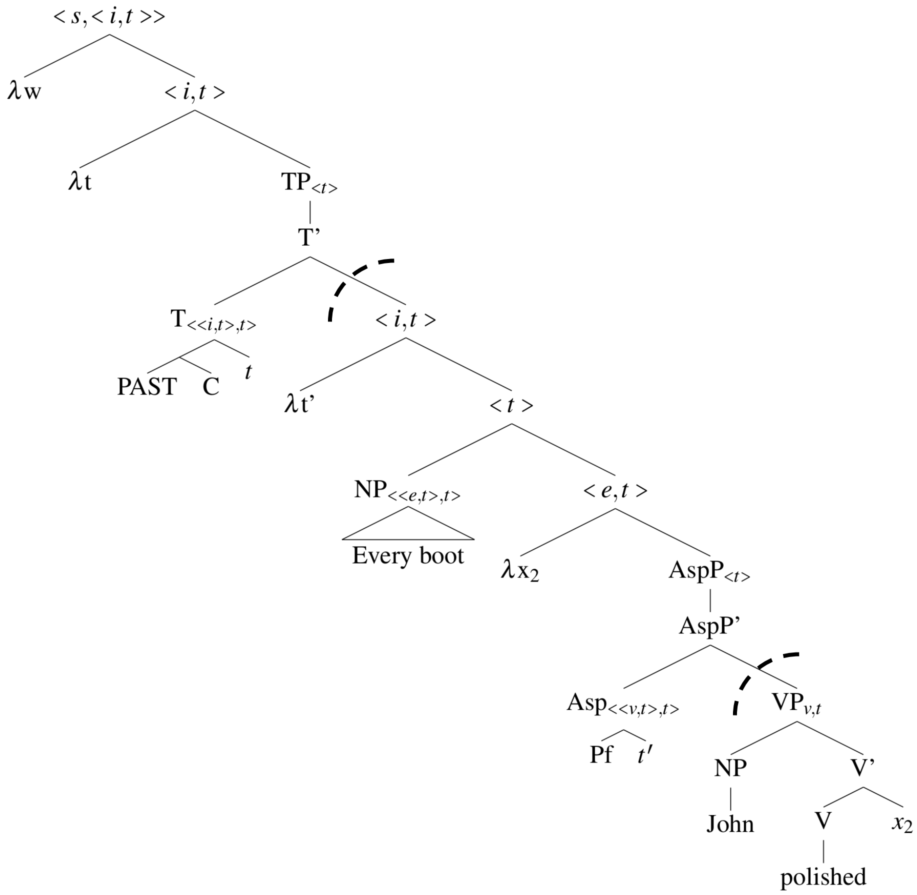
(47) **Enlightened Incrementality Conjecture**:
Units in the same LF domain (DP, VP, TP, AspP). are composed incrementally.

The idea is that there is incremental ('early') composition, but it is limited to a local LF domain. LF domains are defined by semantic type. E.g., we predictively combine the verb with its arguments within the VP <e,t> ('the soup greeted…'). We predictively combine tense with temporal adverbials within the TP layer <i,t> ('Morgen gewann…') and event-level adverbials with expected event descriptions just above the core VP <v,t> ('Susanne hat wieder…'). It appears that predictive composition occurs in layers. (This does not mean that you have to finish a layer before you start the next one, cf. 'Morgen gewann…'.) The tree below illustrates the LF architecture this proposal is based on (e.g. von Stechow and Beck, 2015).



The examples that we have seen for 'delayed' composition, e.g. German aspect/Aktionsart ('Zwei Stunden lang gewann…'), concern material that in the LF is scattered over several layers (TP, AspP, VP). Quantifiers in object position also concern more than one layer: QR takes a quantifier above aspect as illustrated in (48) (e.g. von Stechow and Beck, 2015).

(48)



In sum, late composition facts mean that predictive FA and predictive FC cannot always apply. We conjecture that predictive composition happens in local LF domains, identifiable by semantic type, where the confidence that this is the correct composition is high.

Next steps: There are a couple of issues that need to be addressed for a more complete proposal. The QR data draw our attention to movement and the question of how Predicate Abstraction in standard composition transfers to incremental composition. Analyses are available in CCG (see e.g. Steedman, 2000; Demberg, 2012 for relevant discussion). Similarly, the tense and aspect data show that for an incremental analysis of a complete fragment, we need to think about the interaction of the several LF layers. A proposal is made in Bott and Sternefeld (to appear). We must leave an investigation of these issues, consideration of the available processing evidence and its integration into our proposal for future research.

5. Conclusions

We have seen that semantic processing has incremental properties (e.g. subject + verb seems to be composed immediately) but also 'global' properties, i.e. processing requires larger units (e.g. quantifiers). Standard theories of semantic composition do not model this because they require the whole LF tree and only assign meanings to constituents. Strictly incremental theories of semantic composition do not model this because every sentence prefix is assigned a meaning strictly incrementally. Hence the field is still in search of a model of incremental composition.

We formulate first ideas towards a definition of a heuristic interpretation function $[[.]]_h$ which models incremental composition (keeping as much as possible from standard semantic theories). Our goal is to offer the beginnings of a framework for theories of semantic parsing. Naturally, the question when and to what extent the semantic parser composes incrementally needs to be addressed for further phenomena (variables, decomposition phenomena, presupposition etc.).

Central to our proposal is the enlightened incrementality conjecture: incremental composition occurs within a local LF domain, when the confidence is high that the composition will prove correct.

Our model for a semantic processor concentrates on grammatically determined aspects of incremental interpretation. This is not to deny that other factors may enter into (incremental) understanding. An important factor is what we might call expectations, coming from e.g. frequency, contextual fit or background knowledge. It is clear that these factors affect processing, for example of garden path sentences (e.g. MacDonald, Perlmutter and Seidenberg, 1994) and even scope (Raffray and Pickering, 2010; Chemla and Bott, 2015). We take them to be relevant for our model as well: for instance, the very early effect on *again* noted in section 3 is plausibly due to the kind of context used in the experiment. One way this can be thought about is in terms of when to apply which heuristic rule. Hale (2003) models syntactic expectations by adding the likelihood of the application of a rule of the parser as a probability. A similar path would be open to models of the semantic processor. At any rate, we assume that a component handling such factors can and should be added to what we propose about the processor.

We find it important to model findings on processing in terms of a compositional semantic processor, even though our empirical knowledge in this area is still quite limited. We offer the heuristics in this paper as a framework for beginning this enterprise. If semanticists don't worry about incremental interpretation, and psycholinguists don't model the composition steps, there will be a regrettable gap in linguistic theory. Individual results on semantic processing remain isolated instead of contributing towards a theory of incremental interpretation.

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Embedded disjunctions and the best response paradigm[1]

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Abstract. The current study investigates implicature of embedded disjunctions. We employ a paradigm in which implicatures are inferred indirectly from action choices of test subjects. This avoids meta–linguistic judgements on which previous studies relied. The focus is on four different types of implicature that may be triggered by embedded disjunctions in a situation with a competent speaker. We distinguish between local and global scalar implicatures, exhaustive and existence implicatures. The results provide evidence that varieties all four types of implicature have been inferred by a majority of subjects.

Keywords: experimental pragmatics, embedded implicature, disjunctions.

1. Introduction

The connective '*or*' is one of the core examples illustrating different types of quantity implicature. In (1), the disjunction gives rise to three quantity implicatures, the *scalar* implicature which says that the sentence with '*or*' replaced by '*and*' is false, the so–called *ignorance* or *clausal* implicatures which says that, for all that the speaker knows, it is possible that any of the disjuncts may be true or false, and the exhaustive implicature which says that Kate did not find, for example, the green marble, if she has a green marble:

(1) Kate found her blue or her red marble.
 $\rightsquigarrow$ Scalar: Kate did not find her blue and her red marble.
 $\rightsquigarrow$ Ignorance: $\Diamond$ /$\Diamond\neg$ Kate did find her blue marble;
 $\Diamond$ /$\Diamond\neg$ Kate did find her red marble;
 $\rightsquigarrow$ Exhaustive: Kate did not find any other marble except the blue or the red one.

In this example, the connector is not embedded. The ignorance implicature is inconsistent with a situation in which the speaker knows the actual state of the world. Hence, un-embedded disjunction is generally not licensed in such situations. This marks a difference to embedded '*or*'. For example, '*All of the girls found their red or their blue marble*' can be uttered by a competent speaker.

The current study investigates the complex sentences with embedded disjunctions in (2).

(2) a. All of the girls found their red or their blue marble.
 b. Some of the girls found their red or their blue marble.
 c. All of the girls found their red, their blue, or their green marble.
 d. Some of the girls found their red, their blue, or their green marble.

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In particular, we test the status of the following types of implicature:

(3) (A) the embedded scalar implicature of the disjunction, e.g. for (2a) the implicature '*all either r or b*' leading to an exclusive reading of '*or*';
(B1) the global implicature from (2b) to none $r \wedge b$, and from (2d) to none $r \wedge b$, none $r \wedge g$, and none $b \wedge g$;
(B2) the global implicature from (2b) to not all $r \vee b$, and from (2d) to not all $r \vee b \vee g$;
(C) the exhaustive implicature from (2a) and (2b) to *none found their green marble*;
(D) the strong existence implicature of the embedded disjunctions, for example from (2a) all $(r \vee b)$ to some $r \wedge$ some b.
(D') the weak existence implicature of the embedded disjunctions, for example from (2a) all $(r \vee b)$ to *it is possible that some* r and *it is possible that some* b.

The weak existence implicature (D') is implied by the strong existence implicature (D). We treat them as two variants of the same type of implicature. Likewise, (B1) and (B2) are treated here as two variants of the same type of implicature. The labels have to be understood descriptively. By using them, we do not mean to commit to any specific theoretical framework.

Throughout, we only consider situations in which the speaker is commonly known to be competent, i.e. knowledgeable of the true state of the world. A further assumption is that the objects that can be connected by disjunction are also commonly known. For example, in a scenario in which (2a) is uttered, it will be assumed that each of the girls owns a commonly known finite set of marbles, each with a distinct colour, that could be found by the girl.

Theories make different predictions concerning the implicatures in (3). For example, Chierchia (2004) predicts (A) and a weaker version of (B1), e.g. (2b) $\rightsquigarrow$ (some $r \dot{\vee} b$ and $\neg$all $r \vee b$) but does not address (D). Franke (2009) predicts (A) and (B1), and Sauerland (2004) (B1) and for (2a) a weaker version of (A) $(\neg$all $r \wedge b)$. None of the theories predicts (C), and (D) is only explained by Sauerland (2004) and Crnič et al. (2015) for the sentences with universal quantifier. All theories predict (B2). This is only a sample of the theories about embedded implicature that could be considered (e.g. Asher, 2013; Chierchia et al., 2012; Benz, 2012; Potts et al., 2016). None of the theories addresses all types of implicature, and not all of them are specific enough to be testable.

We present clear experimental evidence that the implicature of types (A), (B1), (C), and (D') can be drawn reliably in a scenario that is based on a game theoretical design (*best response paradigm*, Gotzner and Benz, 2018). In contrast to previous experimental studies (e.g. Geurts and Pouscoulous, 2009; Chemla and Spector, 2011), our paradigm provides an organic setting that avoids meta-linguistic judgement. In the first section, we discuss the general methodological motivation for the best response paradigm. The second section presents the experiments and their results, and the third discusses their evidence for the different types of implicature listed in (3). For example, we will see that there is no evidence for the type (B2) implicature being inferred reliably, which is surprising as they are predicted by all theories. In the fourth section we compare our results to the more recent study of Crnič et al. (2015), who found evidence for strong existence implicatures (D) in absence of implicatures of type (A) and (C).

2. Embedded disjunctions: some theory and some experimental issues

A large body of experimental research on implicatures has emerged over the past decade. The majority of experiments concentrate on questions of acquisition (Noveck, 2001; Papafragou and Musolino, 2003; Katsos and Bishop, 2011), the time course of implicature processing (Noveck and Posada, 2003; Huang and Snedeker, 2009; Grodner et al., 2010; Tomlinson et al., 2013), or the question whether they are generated by default or triggered in context (Breheny et al., 2006). There have been considerably fewer studies on embedded implicatures (Chemla 2009; Geurts and Pouscoulous 2009; Clifton Jr and Dube 2010; Chemla and Spector 2011; Potts et al. 2016; Crnič et al. 2015; Gotzner and Romoli 2017). These studies have employed various paradigms, picture verification tasks (e.g. Geurts and Pouscoulous, 2009), inferencing tasks (e.g. Chemla, 2009), graded acceptability tasks (e.g. Chemla and Spector, 2011), and picture selection tasks (Clifton Jr and Dube, 2010). In these studies, sentences as (2a) are considered ambiguous between a semantic and one or more pragmatic interpretations. The task is to determine whether there is a sub-population that interprets the test sentence in accordance with the critical pragmatic interpretation. There has been a sharp controversy about methodological issues. For example, on the one side it has been argued that inferencing tasks inflate the proportion of pragmatic interpretations (Geurts and Pouscoulous, 2009), and that graded acceptability judgements and picture selection tasks are susceptible to typicality effects (Geurts and van Tiel, 2013; van Tiel, 2014), so that the evidence for embedded implicatures provided by experiments based on these designs may be doubted. On the other side, it has been argued that picture verification tasks induce subjects to interpret semantically, and therefore to underestimate the real proportion of subjects adopting the critical pragmatic interpretation (Clifton Jr and Dube, 2010; Benz and Gotzner, 2014). With the exception of Crnič et al. (2015), the studies were only concerned with embedded scalar implicatures, and generally showed only low proportions of subjects choosing the critical interpretation.

The low proportions may seem unproblematic if the goal is to show that subjects *can* arrive at certain interpretations. In the standard neo-Gricean theory of conversational implicature (Levinson, 1983), implicatures are not alternative readings of a sentence but supplements to semantic content and part of communicated meaning. To show that an interpretation is implicated in this stronger sense, it has to be shown that it is understood by all addressees on a par with semantic content. We are therefore interested in the question which potential implicatures are reliably inferred such that they can count as part of communicated meaning, and which are not. Experiments show a certain degree of random behaviour. We, therefore, can only try to determine, however, which propositions are inferred with high probability, where the term '*high probability*' introduces a certain amount of vagueness.

Pragmatics is about language in use. We, therefore, devised a scenario in which critical sentences are used for communicating facts that the addressee needs to know for subsequent decision making. Our initial hypothesis was that all four types of implicature (A) to (D) are drawn reliably. We will see that the observed response pattern indicates that implicatures of type (A), (B1), (C), and (D') are drawn reliably.

3. The Best Response paradigm

The following experiment takes advantage of the fact that interpretations can be indirectly inferred from action choices of interpreters. In this way, meta-linguistic judgements can be circumvented. As we have argued elsewhere, meta-linguistic judgements, in particular, picture verification tasks, bias subjects towards literal interpretation (Benz and Gotzner, 2014). The presence of a substantial group of literally interpreting subjects dooms any attempt at showing that certain implicatures are communicated reliably. We therefore developed a scenario in which utterance selection and interpretation are embedded in a cooperative action selection task.

3.1. Methods

3.1.1. Participants

Participants with US IP addresses were recruited on Amazon's Mturk platform and were screened for their native language. In total, 20 native English speakers (mean age: 32.7, 13 female, 7 male) took part in the experiment.

3.1.2. Scenario and task

In Gotzner and Benz (2018), we presented the basic version of the best response paradigm. For the current experiment, we use the same basic scenario with minor modifications. Participants in our experiment were presented with a scenario involving four girls who each own a set of three special edition marbles, consisting of a blue, a green and a red marble (a scenario introduced by Degen and Goodman 2014, which we extended with an action-based task). While the girls are playing, the marbles get lost and they have to find them again. Participants in our experiment were told that the mother of the girls wants to reward them depending on how many marbles they find. In particular, participants were presented with the following reward system in the instructions.

(4) Reward system:
- chocolate: all 3 marbles
- candy: 2 marbles
- gummy bear: 1 marble
  - green gummy bear: green marble
  - red gummy bear: red marble
  - blue gummy bear: blue marble
- pretzel stick: 0 marbles

The participants's task in the experiment is to buy sweets as rewards for the four girls depending on the statement the mother utters. After participants had read the instructions, they were asked control questions about the number of marbles each girl owns and which reward type a girl gets depending on how many marbles she found. Then, participants were given an example item involving the statement '*None of the girls found any of their marbles*', in which case they should buy pretzels and nothing else.

3.1.3. Experimental items

In the main part of the experiment, participants were asked to give binary responses (YES/NO) for each of the six types of sweets: chocolate, candy, gummy bears (red, green or blue) and pretzel sticks. There were two types of critical test sentences: either simple or complex disjunction was embedded under *all* and *some*. The test sentences are shown in (5). Our four critical sentences were repeated twice in the experiment.

(5)
a. All of the girls found their red or their blue marble.
b. Some of the girls found their red or their blue marble.
c. All of the girls found their red, their blue, or their green marble.
d. Some of the girls found their red, their blue, or their green marble.

An example experimental trial with All $(r \vee b)$ and a possible response choice is presented in (6). Participants had to check one of two radio buttons ('YES' or 'NO') for each type of sweets.

(6)

The mother says:	'All of the girls found their red or blue marble'	
chocolate	○ YES	⊙ NO
candy	○ YES	⊙ NO
green gummy bear	○ YES	⊙ NO
red gummy bear	⊙ YES	○ NO
blue gummy bear	⊙ YES	○ NO
pretzel stick	○ YES	⊙ NO

In addition, participants saw 15 filler items such as the statement 'Sue and Kate found some of their marbles' as well as the original test sentences used in Gotzner and Benz (2018) involving the quantifier *some* embedded under *all* and *some* itself. Hence, each participant saw 23 items in total.

3.2. Results

Figure 1 shows the mean percentage of YES responses across reward type for simple disjunctions and Figure 2 shows the data for complex disjunctions (Table 4 in the appendix details the percentages of each combination of action choices per condition). We computed two separate logit mixed models for simple and complex disjunctions. Our dependent variable was binary (choice of sweet: 1 or 0) and we included the fixed factors quantifier condition (All $(r \vee b)$ vs. Some $(r \vee b)$), reward type (candy, chocolate, red, green, blue gummy bear, pretzel stick), their interaction as well as random factors for participants and items. As reference level we chose the condition (All $(r \vee b)$, candy) and (All $(r \vee b \vee g)$, candy) respectively.

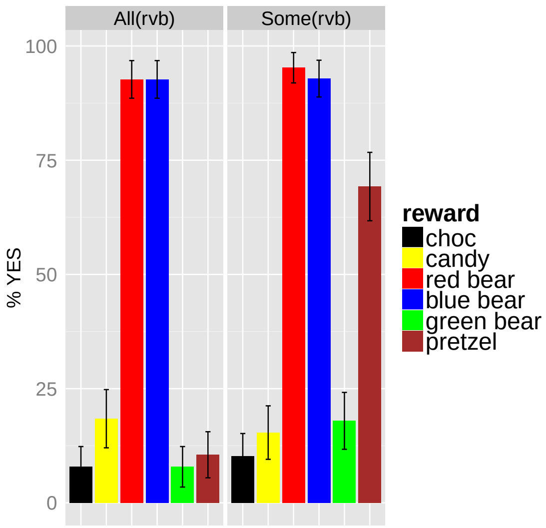

Figure 1: % YES responses for sentence All $(r \vee b)$ (left column) and Some $(r \vee b)$ (right column) across reward type. Error bars represent SEM.

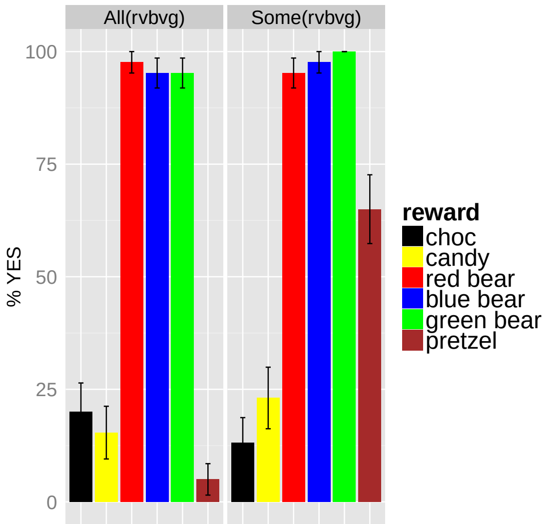

Figure 2: % YES responses for sentence All $(r \vee b \vee g)$ (left column) and Some $(r \vee b \vee g)$ (right column) across reward type. Error bars represent SEM.

Mixed model for simple disjunctions. The model showed a significant difference across reward type: Participants chose candy less often than red bears ($p < .001$) and blue bears ($p < .001$). There was no difference between the two quantifier conditions at the baseline level or between candy and the other two reward types. However, the model revealed an interaction between quantifier condition and reward type (pretzel : Some $(r \vee b)$: $p < .0001$). Table 5 in the appendix shows a summary of the mixed model.

Mixed model for complex disjunctions. The model showed a significant difference across reward type: Participants chose candy less often than red bears, green and blue bears (all p's $< .0001$). There was also a marginal difference compared to the condition with pretzels ($p = .09$) as well as an interaction across condition and reward type (pretzel : Some $(r \vee b \vee g)$ $p < .001$). There were no further main effects nor any interactions. Table 6 in the appendix shows a summary of the mixed model.

4. Evaluation of results

We tested the four sentences presented in (2). The task of the participants was to buy sweets for the four girls. They were asked to give binary responses (yes/no) for each of the six types of sweets: chocolate, candy, red, blue, and green gummy bears, and pretzel sticks. If subjects draw the implicatures (A)–(D), then their expected response pattern is that shown in (7).

(7)

condition		choc.	candy	red b.	blue b.	green b.	pretzel
(2a)	All $(r \vee b)$	no	no	yes	yes	no	no
(2b)	Some $(r \vee b)$	no	no	yes	yes	no	yes
(2c)	All $(r \vee b \vee g)$	no	no	yes	yes	yes	no
(2d)	Some $(r \vee b \vee g)$	no	no	yes	yes	yes	yes

As we have seen, the observed choices conform to this prediction. The only exception are the choices with respect to pretzels in the *some*-conditions. We observe a larger proportion of subjects buying no pretzels (about 30%),[2] which is inconsistent with there being a group of girls that found none of their marbles. This implicature follows from an utterance of (2b) by the following reasoning: First, with (B2) Some $(r \vee b)$ implicates $\neg$all $(r \vee b)$; second, (C) implies that none found the green marble. Together, this implies that some found none. If subjects would not adhere to (C), then they should have bought either chocolate, candy or green gummy bears in the '*some* $(r \vee b)$' condition (2b). As they did not buy them, the problem must be the implicature of type (B2). Hence, the experiments indicate that there is a significant proportion of subjects that do not draw the (B2) implicature, i.e. global scalar implicature from embedding '*some*'. However, we can conclude that the hypothesis that subjects draw implicatures (A), (B1), (C), and (D) is *consistent* with the experimental results.

We next consider the more difficult question of how far the results shown in Table 4 in the appendix *imply* that subjects infer (A), (B1), (C), and (D). As the percentage values follow the

[2] A mixed model analysis with disjunction embedded under *some* and the reward type pretzels as reference level revealed that this condition differed significantly from all other reward types (all p's $< .001$, both for simple and complex disjunctions).

response pattern shown in (7), with the exception of the pretzel results for (2b) and (2d), we abstract from the precise numerical values and concentrate on the evidence provided by the categorical pattern in (7). What we have to show is that for all possible belief states that are consistent with the subjects's choices of sweets, the implicatures generated by (A), (B1), (C), and (D) hold true.

In our scenario, each observable world can be identified with a 4-tuple (m_1, m_2, m_3, m_4) of sets of marbles $m_i \subseteq \{b, g, r\}$. The set m_i represents the set of marbles found by the i^{th} girl. There are $(2^3)^4 = 4096$ different observable worlds. The reward system with different kinds of sweets distinguishes $2^6 - 1 = 63$ relevant states, of which $\sum_{i=1}^{4} \binom{6}{i} = 56$ can be instantiated by four girls. In the following, we mean by '*possible world*' always one of the 63 possible worlds defined by the reward system, and not one of the observable worlds.

We consider the four conditions (2a) to (2d) one after the other. First, let us consider (2a):

(2a) All of the girls found their red or their blue marble.

This sentence is semantically consistent with 24 possible worlds, 8 of which are shown in Table 1. The other 16 worlds can be found by making one copy of the table and replacing the 1s in the '*blue*' column by 0s, and then by making another copy and replacing the 1s in the '*red*' column by 0s. Of the 24 worlds only one world is consistent with the pragmatic choice as indicated by the ✓ in the last column.

Possible worlds (8 of 24)

pretzl	blue	green	red	candy	choc	cons
0	1	1	1	1	1	–
0	1	1	1	1	0	–
0	1	1	1	0	1	–
0	1	1	1	0	0	–
0	1	0	1	1	1	–
0	1	0	1	1	0	–
0	1	0	1	0	1	–
0	1	0	1	0	0	✓

Information states consistent with choice

inf. state	pretzl	blue	green	red	candy	choc
I	0	1	0	1	0	0
II	0	1	0	1	0	0
	0	1	0	0	0	0
III	0	1	0	1	0	0
	0	0	0	1	0	0
IV	0	1	0	0	0	0
	0	0	0	1	0	0

Table 1: Target sentence (2a) *All of the girls found their red or their blue marble.*

If the addressee infers an exact state of the world, then we can conclude that she believes to be in the world indicated by ✓. However, there are three other belief states that are consistent with the choice of only red and blue gummy bears. They are also shown in in Table 1. The experimental set up does not allow us to distinguish between the four states. We now have to check whether the implicatures predicted by (A), (B), (C), and (D) are supported by all four of them. (A) is the embedded implicature that none found both the red and the blue marble; if the addressee believes that this implicature might be false, then there must exist a belief world in which it is appropriate to buy hard candy; as in neither of the four belief states there exists such a world, we can conclude that the addressee does not believe it possible that the implicature is false. Hence, the embedded implicature (A) is true. (B1) and (B2) only apply to the '*some*' sentences. The exhaustive implicature (C) that none found the green marble is also true in all belief states. We can also immediately see that the weak existence implicature (D') holds: each belief state contains a world with a 1 in the *red* column, and a world with a 1 in the *blue* column; hence, in each belief state it is possible that a girl found a red marble and it is possible that a girl found a blue marble. The stronger existence implicature (D) is violated in information states II, III, and IV: in each of these states there is a world in which either the *red* column contains a 0 or the *blue* column.

We next consider condition (2b):

(2b) Some of the girls found their red or their blue marble.

This sentence is semantically consistent with 48 possible worlds, 9 of which are shown in Table 2. The 48 worlds consist of the 24 worlds consistent with (2a) together with a copy of these worlds where the 0s in the '*pretzel*' column are replaced by 1s. Of the 48 worlds only two worlds are consistent with the experimental results: one world consistent with the choice of the subjects who bought pretzels, and one world consistent with the choice of the subjects who did not by them. The two worlds are indicated by ✓ in the last column of Table 2.

Possible worlds (9 of 48)

pretzl	blue	green	red	candy	choc	cons
1	1	1	1	1	1	–
1	1	1	1	1	0	–
1	1	1	1	0	1	–
1	1	1	1	0	0	–
1	1	0	1	1	1	–
1	1	0	1	1	0	–
1	1	0	1	0	1	–
1	1	0	1	0	0	✓
0	1	0	1	0	0	✓

Information state consistent with choice (1 of 57)

pretzl	blue	green	red	candy	choc
1	1	0	1	0	0
1	1	0	0	0	0
1	0	0	1	0	0
0	1	0	1	0	0
0	1	0	0	0	0
0	0	0	1	0	0

Table 2: Target sentence (2b) *Some of the girls found their red or their blue marble.*

For (2b), there are many more belief states than for condition (2a). One belief state is shown in Table 2. We can generate 57 belief states by taking all subsets of this state which contain a world with a 1 in the '*blue*' column and a world with a 1 in the '*red*' column.

If the addressee believes to be in one of the worlds indicated by ✓, then she believes in the implicature generated by (A), (B1), (C), and (D). If it is the world with a 1 in the '*pretzel*' column, then she also draws the global scalar implicature for embedding '*some*' (B2). Our results showed that this is true only for about two-third of the subjects. If no belief state contains a world where candy or chocolate has to be bought, then the addressee must believe in the (A) implicature. As all belief states are subsets of the one shown in Table 2, this holds true. The global implicature of embedded '*or*' (B1) says that none of the girls found the red and the blue marble. This follows from the fact that no belief state contains a world in which candy or chocolate has to be bought. The global implicature (B2) stating that not all girls found the red

A	B		D	E	F
A	B				F
A			D	E	F
A			D		F
A	B				F

Table 3: A critical item probing for existence implicature from Crnič et al. (2015: p. 15).

or the blue marble is violated if a belief state contains a world with a 0 in the '*pretzel*' column. We have seen that such belief states are not ruled out by our data. There is a larger proportion of subjects whose choice of sweets is consistent only if they are not drawing the (B2) implicature, as we have argued before. The exhaustive implicature (C) that none found the green marble is true in all belief states. We can again immediately see that the weak existence implicature (D') holds. The stronger existence implicature (D) is violated in all but three belief states.

For the remaining conditions (2c) and (2d), the claims follow by analogous arguments.

(2c) All of the girls found their red, their blue, or their green marble.
(2d) Some of the girls found their red, their blue, or their green marble.

The motivation for testing these sentences in addition to (2a) and (2b) was that deriving the embedded scalar implicatures (A) for double disjunction in contrast to single disjunction is more difficult in localist frameworks (Chierchia et al., 2012). However, our results do not indicate any significant difference between them.

5. Comparison with Crnič et al.

Our aim was to test whether the different types of implicature associated with embedded '*or*' are part of communicated meaning. Within common error ranges, subjects followed the response pattern shown in (7), except for '*some*' sentences, for which a substantial proportion of subjects failed to infer that some of the girls found none of the marbles. This pattern suggests that indeed implicatures from (A), (B1), (C), and (D') are reliably drawn in our scenario. As mentioned earlier, the goal of our study contrasts with that of many other studies of embedded implicature. A relevant example is that of Crnič et al. (2015) who tested for strong existence implicature in a picture verification task. They only considered sentences of type (2a), i.e. no sentences with embedding '*some*':

(8) Every box contains an A or a C.

A critical picture is shown in Table 3. For this picture, a significant proportion of subjects rejected sentence (8) while almost all accepted the following sentences:

(9) a. Every box contains a B or a D.
b. Every box contains an A or a B.
c. Every box contains an A or an F.

As the strong existence implicature (D) from sentence (8) is false in the given situation, it can be inferred that some subjects draw this implicature. As subjects accepted (9b) and (9c), they must have ignored the embedded scalar implicature (A), as well as the weaker global scalar implicature from '*all* $p \vee q$' to '$\neg$*all* $p \wedge q$'. None of the sentences in (9) is consistent with the exhaustive implicature (C). Hence, the results differ significantly from our study. We assume that this difference is due to the different tasks the subjects had to perform. As mentioned before, picture verification tasks push subjects to purely semantic interpretations. In contrast, we provided them with an action selection task which does not directly involve reasoning about truth conditions. This does not necessarily entail that one design is deficient, and the other does it right. They simply test interpretation in different contexts. The question is what we want to find out about language use. Crnič et al. (2015) wanted to show that there exist a non-empty group of subjects that draw existence implicatures without drawing other implicatures. They are not concerned with showing that they are drawn by almost all subjects. The critical sentence was accepted in 78.4% of all occasions, in contrast to 97% and 93.1% for sentences (9b) and (9c). Hence, the existence implicature has been inferred in at most 22% of all cases in which a critical sentence was presented. In terms of individuals, they found that only 6 out of 51 subjects drew the existence implicature consistently. It is clear that these percentages could not count as evidence that they are drawn reliably.

A drawback of the design we used is that it is not sensitive to the distinction between weak and strong existence implicature. We would have to rule out uncertainty about interpretations on the hearer side. If their belief states consist of only one world, for example of the worlds marked by ✓ in Tables 1 and 2, it would be obvious that the strong existence implicature is inferred. In order to show that uncertainty can be ruled out, we have to develop our paradigm further.[3]

6. Conclusions

The results of our study provide clear evidence that participants compute local scalar implicatures (A), global implicature for strengthened '*or*' (B1), exhaustive implicaures (D), and weak existence implicature (D'). If uncertainty about interpretation on the hearer side can be ruled out, the strong existence implicature (D) can be assumed. We were concerned with implicature as part of communicated meaning. Hence, we had to show that a very high proportion of subjects draw these implicatures. As shown in the introduction, none of the existing theories can account for all these implicatures. In our previous discussions, we have not addressed the issue of how the observed implicature can be accounted for theoretically. The contrast between picture verification tasks, for example (Geurts and Pouscoulous, 2009; Crnič et al., 2015), and the best response paradigm (Gotzner and Benz, 2018) show that context specific parameters, as for example shared assumptions about the speaker's knowledge about the exact state of the world, and general domain tasks that define relevant meaning differences, play a crucial role in implicature generation.

[3]To simply add an answer option '*I don't know*' to the options '*yes*' and '*no*' would not be enough as this option introduces new uncertainties about its interpretation.

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7. Appendix

7.1. Instructions

Ann, Sue, Mary and Kate are sisters. They are really into collecting marbles. Each of the sisters has a set of 3 special edition marbles. One set consists of a green, a blue, and a red marble. Each set is special, so the girls know which marble belongs to whom. Their mother is playing a game with them. She hides their marbles in the house. Then the girls search for their sets. In the end, they receive a reward.

- If a girl finds
  - call 3 of her marbles, she will win a chocolate
  - 2 of her marbles, she will win a candy
  - 1 of her marbles, she will win
    a red gummy bear, if she found her red marble
    a green gummy bear, if she found her green marble
    a blue gummy bear, if she found her blue marble
  - 0 of her marbles, she will win a pretzel stick as consolation prize.

The mother is really good at hiding marbles. So, it is really difficult for the girls to find them. The girls never help each other, and if one of them spots the marble of another one, then she ignores it. In this experiment you will read sentences that were uttered by the mother after she checked the marble bags.

Before you begin the experiment, please answer the following question: How many special edition marbles does each sister own? ___
What reward will a girl get when she has found...
all 3 of her marbles? ___
only 2 of her marbles? ___
only 1 of her marbles, if she found the red one? ___
only 1 of her marbles, if she found the green one? ___
only 1 of her marbles, if she found the blue one? ___
none of her 3 marbles, if she found the red one? ___

The Main Task:

Please decide which sweets you would buy as a reward for the girls depending on the mother's statement.

7.2. Detailed percentages of action choice across conditions

Reward/condition	All $(r \vee b)$	Some $(r \vee b)$	All $(r \vee b \vee g)$	Some $(r \vee b \vee g)$
candy	18%	15%	20%	13%
chocolate	8%	10%	15%	23%
green bear	8%	18%	95%	100%
red bear	93%	95%	98%	95%
blue bear	93%	93%	95%	98%
pretzel stick	11%	69%	5%	65%

Table 4: Different reward choices for simple and complex disjunctions embedded under *all* and *some*

	Estimate	SD	z-value	p-value
(Intercept)	-1.7518	0.5292	-3.310	0.000932
choc	-1.2033	0.8227	-1.463	0.143590
red bear	4.6708	0.7963	5.866	0.000
blue bear	4.6600	0.7943	5.867	0.000
green bear	-1.2074	0.8235	-1.466	0.142592
pretzel	-0.8132	0.7560	-1.076	0.282065
Some $(r \vee b)$	-0.2592	0.6805	-0.381	0.703291
choc : Some $(r \vee b)$	0.6246	1.1228	0.556	0.577997
red bear : Some $(r \vee b)$	0.7245	1.1758	0.616	0.537774
blue bear : Some $(r \vee b)$	0.2909	1.1019	0.264	0.791762
green bear : Some $(r \vee b)$	1.4368	1.0685	1.345	0.178716
pretzel : Some $(r \vee b)$	3.8622	0.9969	3.874	0.000107

Table 5: Summary of logit mixed effects model for simple disjunction
(n = 474, log-likelihood = -150.9)

	Estimate	SD	z-value	p-value
(Intercept)	-2.44296	0.69573	-3.511	0.000446
choc	0.52841	0.73897	0.715	0.474567
red bear	7.20754	1.27769	5.641	0.000
blue bear	6.40951	1.04230	6.149	0.000
green bear	6.41877	1.04435	6.146	0.000
pretzel	-1.71050	1.01189	-1.690	0.090951
Some $(r \vee b \vee g)$	0.72414	0.73288	0.988	0.323119
choc : Some $(r \vee b \vee g)$	-1.54500	1.07413	-1.438	0.150329
red bear : Some $(r \vee b \vee g)$	-1.53248	1.48651	-1.031	0.302576
blue bear : Some $(r \vee b \vee g)$	0.04538	1.47837	0.031	0.975511
green bear : Some $(r \vee b \vee g)$	20.60431	273.67643	0.075	0.939986
pretzel : Some $(r \vee b \vee g)$	4.45654	1.23688	3.603	0.000314

Table 6: Summary of logit mixed effects model for complex disjunction
(n = 488, log-likelihood = -117.7)

The pragmatic ingredients to get perfect biscuits[1]

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Abstract. Building on previous work, we present a proposal for a pragmatic account of biscuit conditionals (BCs). We present a new phenomenon that we dub *biscuit perfection* to support our proposal and argue that differences between BCs and hypothetical conditionals can be explained once we consider the relation between *if*-constructions and discourse.

Keywords: Biscuit conditionals, contrastive topic, inferences in conditionals, causality.

1. Introduction

There is a contrast between the two *if*-constructions in (1):

(1) a. If you are hungry, I'll give you some biscuits.
b. If you are hungry, there are biscuits on the sideboard.

In its most prominent reading, an utterance of (1a) conveys that whether I give you biscuits or not depends on you being hungry. *If*-constructions with this reading are often called hypothetical conditionals, (HCs). In contrast, by uttering (1b) the speaker conveys that there are biscuits on the sideboard regardless of whether you are hungry or not, and in addition conveys a suggestion to eat the biscuits to still hunger. *If*-constructions with this reading are called *biscuit conditionals* after Austin's (1956) original example or, e.g., *relevance conditionals* (although in these cases the consequent is not at all 'conditional' on the antecedent). This contrast has been characterized as a difference in information update within a Stalnakerian model of communication (Stalnaker, 2002, 2014): the consequents in HCs update only the temporary context created by the antecedent clause, while in BCs the consequents update the entire context set. Theories of biscuit conditionals have aimed to explain this contrast, which we dub the *global update puzzle* (GUP). A second issue is why a speaker would utter (1b) instead of the plain declarative *there are biscuits on the sideboard*. We dub this second question the *conditional form puzzle* (CFP). As a third point, we would also like to understand how the 'extra meaning' pertaining to a suggestion arises in examples like (1b).

There are, roughly, two linguistic approaches to the study of BCs. Semantic theories (DeRose and Grandy 1999; Siegel 2006; Ebert et al. 2014 a.o.) claim that BCs and HCs have different logical forms that result in a different interpretation. Such accounts provide explanations for the GUP and the CFP and can also account for the fact that an utterance of (1b) conveys a suggestion.

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Pragmatic theories (Franke 2007, 2009; Sano and Hara 2014; Lauer 2015; Francez 2015 a.o.), in contrast, argue that the semantic meaning of *if*-constructions is the same and differences between HCs and BCs are derived pragmatically taking into account the independence between antecedent and consequent.

While semantic theories are designed to explain all the points in our desiderata so far, pragmatic theories have focused on how to derive the GUP, with the other puzzles often only sketched. In this paper we defend a pragmatic view of BCs. We build on previous work to provide a fleshed-out account of the factors that result in *if*-constructions being interpreted as either HCs or BCs. We further argue that the pragmatic mechanisms underlying one or the other reading of *if*-constructions are independently motivated. This point will be made by exploring new data illustrating a phenomenon that we call *biscuit perfection*. An example is provided in (2) (with prosodic annotations resulting from a pilot study, see §4 for more details):

(2) a. Oh, you are making pasta bolognese!
If you need wine for the sauce... there is a bottle by the microwave.
(L)-H* L+H* L-H%
b. Oh, you are making pasta bolognese!
If you need wine for the sauce... there is a bottle by the microwave.
L+H* L-H%

The two different prosodic patterns above lead to two different interpretations. In (2a), representing a "neutral" pattern, the speaker is not suggesting that the wine should not be used for other purposes, such as drinking (though such inferences could arise as a result of world-knowledge regarding the kinds of wine we cook with.). However, with the prosody in (2b) the speaker indicates that the recommendation to use the wine by the microwave extends only to the making of the sauce (i.e. the speaker wouldn't recommend drinking the wine). In this case, the suggestion inference we had already noted is strengthened to be applied only in the circumstances described by the antecedent. We call this *biscuit perfection*. A theory of BCs should also explain how biscuit perfection is derived, which becomes now the fourth point in our desiderata. As we will show, accounting for biscuit perfection requires taking into account the mapping between BCs and discourse structure, providing independent support for a pragmatic account of BCs.

The reminder of the paper is organized as follows: in §2 we briefly explain how pragmatic theories solve the GUP and introduce the notion of independence in BCs. In §3 we make a proposal regarding how BCs map into discourse. We argue that this mapping is what triggers the inferences in BCs. The case of perfect biscuits, §4, provides support for the idea that the mapping of BCs into discourse is crucial in the construction of meaning. Biscuit perfection is argued to be no more than C(ontrastive)T(opic)-marking in BCs. We conclude with a comparison between the resulting theory and semantic theories of BCs in §5.

2. Strengthening the consequent to a global update (GUP)

2.1. Independence

Pragmatic theories claim that independence between antecedent and consequent is key to biscuithood (in HCs they are dependent). However, there are different takes on how to spell out what it means for propositions to be independent (Merin, 2007; Sano and Hara, 2014; Francez, 2015; Franke, 2009). Here, we will confine ourselves to an informal characterization of independence emphasizing the core insight shared by the different positions.[2] Independence is regarded as an epistemic notion defined relative to an agent's information state.

(3) Epistemic independence of propositions
Two propositions ϕ, ψ are independent relative to an information state Σ iff learning the truth of ϕ does not provide information regarding ψ and vice-versa.

With this rough characterization of independence at hand let us turn now to the semantics of indicative *if*-constructions. We will then be prepared to tackle the GUP.

2.2. A dynamic semantics for the (indicative) *if*-constructions and the GUP in BCs

We employ a dynamic semantics for (indicative) *if*-constructions operating on a Stalnakerian *context set* c, the global context.[3] The meaning of an expression is its context change potential (CCP), i.e. a function from contexts to (updated) contexts. The CCP of a simple declarative proposes to eliminate from c all worlds in which the corresponding proposition is false. For conditionals, we adopt Heim's (1983) CCP (see Biezma and Goebel 2017 for an analysis building on Isaacs and Rawlins's 2008 proposal using a stack-based model):

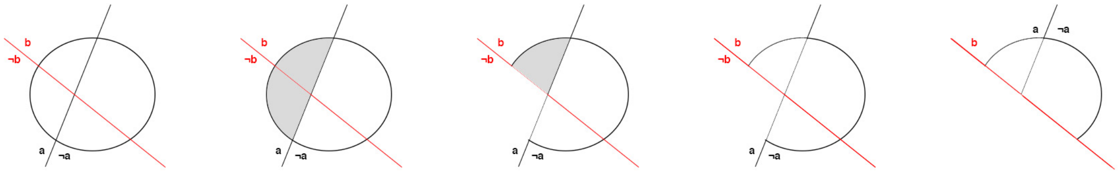
(4) Conditional declarative update: Where $M\backslash N = M \cap (W - N)$
$c + \mathit{If}\ \alpha, \beta = c \setminus (c + \alpha \setminus c + \alpha + \beta)$, where α and β are declarative clauses.

To evaluate a conditional, the antecedent clause sets up a temporary context $c+\alpha$ containing only worlds where the antecedent is true. Given that indicative conditionals presuppose that the antecedent proposition is a live option in c, $c+\alpha$ is a subset of c. Furthermore, $c+\alpha$ is updated with the consequent β. Complementation in $(c+\alpha \setminus c+\alpha+\beta)$ gives us all $\alpha \wedge \overline{\beta}$-worlds, i.e. those worlds eliminated when $c+\alpha$ is updated by β. In the final step, all $\alpha \wedge \overline{\beta}$-worlds are eliminated from the global context c.

However, for BCs this is not the end of the story. In pragmatic accounts of BCs following Franke (2009), the interplay with the contextual assumption of independence has the effect of eliminating all $\overline{\beta}$-worlds from the global context c, not only $\alpha \wedge \overline{\beta}$-worlds. Why is this so? The proposal is that in the context prior to the utterance of the BC there is a shared contextual assumption of

[2] The reader is referred to Biezma and Goebel (2017) for a full discussion and an improved alternative.

[3] Here we restrict ourselves to indicative BCs. In Biezma and Goebel (2017) we extend our account to also cover subjunctive BCs as observed by Swanson (2013) and further subjunctive cases.



(a) (b) (c) (d) (e)

Figure 1: Dynamic update and strengthening in BCs

independence between antecedent and consequent (while in HC-interpretations we take them to be dependent). We follow Francez (2015) in postulating that this means that dependence is excluded by shared world-knowledge of “causal and epistemic relations”. Independence enforces that in c all possible truth-value distributions over antecedent and consequent are possible, as depicted in fig. (1a). This structure makes sure that learning that either the antecedent or the consequent is true doesn’t provide information regarding the other proposition. The utterance of the conditional proposes to update c by first creating a temporary context $c+\alpha$ formed by all the α-worlds (fig. (1b)), and then eliminating from them the $\overline{\beta}$- worlds, leaving us only the $\alpha \wedge \beta$-worlds (grey area in fig. (1c)). At this point we return to the global context where all $\alpha \wedge \overline{\beta}$-worlds are eliminated (fig. (1d)). However, the induced structure on c depicted in (fig. (1d)) clashes with the independence assumption. The latter requires that learning about the truth of one proposition does not imply learning anything about the other proposition. In contrast, the structure depicted in fig. (1d) is fit for *modus ponens*, i.e. if the truth of the antecedent is learned, the truth of the consequent is also learned in c since after an update with α there are only $\alpha \wedge \beta$-worlds left. Hence, we arrive at a contradiction, since α and β are *not* independent here. The clash of the independence assumption and the semantically encoded update exerts *pragmatic pressure* on the addressee to modify her view of the context while preserving the assumptions of independence and that there are worlds in the context set in which the antecedent is true. With these constraints the only way to retrieve a coherent context set is to eliminate all $\overline{\beta}$-worlds from the global context c (fig. (1e)). In the resulting context set, in which β is always true, learning whether the antecedent α is true or false does not allow us to learn anything about the status of β, preserving in this way the assumption of independence as well. Hence, it is the assumption of independence what accounts for the GUP.

It is important to note that strengthening as described is a rational reconstruction and not an explicit reasoning process the interpreter goes through. Strengthening is a contextual entailment that is not cancellable, because it is an entailment of the context set given that certain presuppositions, i.e. independence and antecedent possibility, are met.

3. The discourse function of BCs

Having explained the GUP, let us tackle now the CFP: why does a speaker utter a BC when the utterance of the main clause alone (the consequent) would apparently suffice? We believe that part of the answer, following Franke (2009) and going back to DeRose and Grandy (1999), is that BCs help to establish relevance (and hence felicity) of the utterance. The following example (adapted from Franke 2009: 275) illustrates the point:

(5) B has been helping A to pack for a trip by handing him stuff, and is obviously tired:
A: There are biscuits on the sideboard.
[B hands out the cookies to A who starts laughing. A explains that he was just suggesting that B eat them since he looks tired and sugar would do him good.]

B's interpretation of A's utterance was perfectly coherent given the overall context, but that is not what A intended (hence the laughter). Uttering the BC 'If you are hungry, there are biscuits on the sideboard' would have avoided the confusion and would have unambiguously resulted in the intended interpretation, i.e. that the speaker is suggesting that B eat some biscuits. The BC would have informed the addressee about the presence of biscuits on the sideboard and <u>also</u> about the intended context for that information. In this way the BC is more informative (while relevant) than the utterance of the main clause alone.[4] We now must face the question of how to capture the intuition that the participants' overall interpretation is that the speaker is providing the <u>relevant context</u> for that information as well as suggesting that the addressee eat the biscuits.

It is worth noting that classic BCs are not the only conditionals where antecedent and consequent are independent. Other examples have been discussed in the literature under the label of *non-interference* conditionals (see discussion in Bennett 2003: 122). In these cases, the intuition is also that our beliefs about the consequent proposition are unaffected by our beliefs about the antecedent. Bennett offers the following example:

(6) I express fear that the refrigerator will explode if you open its door, and you assure me that if I open the door, it won't explode. You base this on your belief that the door-opening and the non-explosion are irrelevant to one another, and put it in conditional form because I think they are connected. (p. 123)

In pursuing a unified analysis, we would conclude that examples like this are of the same kind as traditional BCs, with differences that should follow from pragmatics. This is interesting because in the case of non-interference conditionals, the role of the conditional does not (always?) seem to be to establish relevance. Consider the following example:

(7) A: Oh look at the weather! It's probably going to rain. Poor Betsy is still out there. She will get completely soaked.
B: Don't worry. She has her umbrella.
A: But the poor child! This is terrible! Dreadful!
B: Stop exaggerating. If it rains, she has her umbrella.

B's utterance of the conditional is not meant to establish relevance (this was already clear!). B's point is to emphasize that Mary has her umbrella. If the only discourse purpose of the 'independent' conditionals were to establish relevance, it would have been redundant, but it is

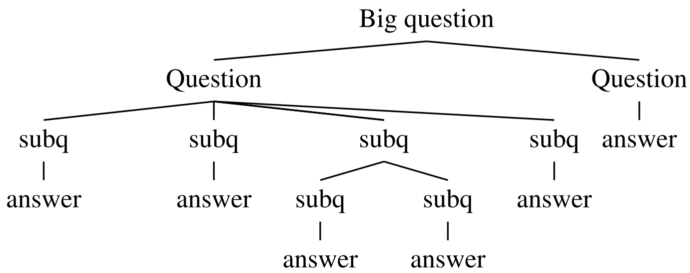
[4]This can be formalized in a number of neo-Gricean approaches, see Potts (2006) and reference therein a.o.

not. We will not be able to investigate all cases of *if*-constructions with independent antecedents and consequents. Our focus remains on ‘classic’ BCs. But the observation that there is a larger group, and that some members of that group do not appear to serve the discourse function of establishing relevance, is important in terms of deciding how it is that BCs come to establish relevance. A theory of BCs has to derive the old intuitions that BCs help to establish relevance, but also allow *if*-constructions with independent antecedents and consequents to serve other purposes, since they can also be used in scenarios like (7). In what follows we argue that the key is to be found in how conditionals map into discourse.

3.1. The mapping of *if*-constructions into discourse

We adopt the Q(uestion) U(nder) D(iscussion) discourse model (Roberts 1996; Büring 2003 a.o.) in which conversation is taken to be a cooperative inquiry and is modeled as as a hierarchical order of moves. Discourse moves are understood as either answering a (implicit) question (pay-off moves) or setting up a question for participants to answer (set-up moves). The hierarchical nature of discourse can be represented by Büring’s (2003) D(iscourse)-trees:

(8)



Each node in the tree represents a *discourse move*. Participants can adopt *strategies* to address a given question (a strategy is a set of subquestions to the dominating question). Well-formedness in discourse is constrained by several notions, amongst them entailment and relevance:

(9) **Entailment:** One interrogative q_1 entails another q_2 iff every proposition that answers q_1 answers q_2 as well.
Relevance: A move M is *Relevant* to a question q iff M either introduces an (at least) partial answer to q in context c_M (M is an assertion) or is part of a strategy to answer q (M is a question).

The question now is how *if*-constructions map into discourse. Haiman (1978) already claimed that the antecedent clause in *if*-constructions is understood as establishing the topic of the utterance. In the QUD model this translates into the antecedent establishing the question that is being addressed. The consequent, on the other hand, provides the answer. This mapping is also suggested for BCs in Starr (2014) (although not directly in the QUD model), and Ebert et al. (2014). However, these proposals either encode the mapping in the semantics of *if*-constructions without allowing for other possibilities (which we will see is problematic), or fail to explain why this is the only possible mapping in BCs. A *default* mapping of *if*-constructions does not mean that other mappings are not possible. It has been argued, for example, that focus particles associating with the entire antecedent proposition makes conditionals reverse this default mapping to one in which the consequent presents the QUD while the antecedent provides the answer (Biezma 2011a, b). This reverse mapping can also be forced contextually and has been claimed to be necessary in von Fintel (2009) to explain classic conditional perfection:

(10) A: When would you give me $5?
B: Well, if you mow the lawn, I'll give you $5.
$\rightsquigarrow$ If you don't mow the lawn, I won't give you $5. [Conditional perfection]

Conditional perfection arises when the antecedent is understood as an exhaustive answer to the on-going question presented by the consequent.

The discussion above argues against encoding the mapping between *if*-constructions and discourse in the semantics. In what follows we first assume that in BCs the antecedent always indicates the QUD, while the consequent provides the answer. This mapping, we argue, explains how inferences arise in BCs (when they do) and allows us to explain why some BCs are infelicitous. We close the section by explaining why this is the only possible mapping for the cases we identify as BCs.

3.2. Inferences in *if*-constructions and discourse-relevance

Under our unified perspective, an *if*-construction of the form *if* α, β will be true iff in all 'relevant' worlds in which α is true, β is also true (where 'relevant' depends on the particular theory of conditionals and how such theory restricts the domain of quantification). Assuming the default mapping of *if*-constructions, a BC (posits and) answers the following question:

(11) 'What do the 'relevant' worlds in which α is true look like?' ($\simeq$ What if α?)[5]

The consequent is interpreted as a (relevant) response to such question. This relevance assumption, we argue, is what gives rise to inferences in BCs:

(12) QUD: What do the relevant worlds in which the addressee is hungry look like?
($\simeq$ What if the addressee is hungry?)
Answer: There are biscuits on the sideboard.

Given that the consequent is taken to be a relevant response to the established question the addressee reasons that the speaker is trying to provide a way to solve hunger.[6] In paradigmatic cases of BCs like (1b), reasoning towards the relevance of the consequent as the answer to the question set by the antecedent leads the addressee to additionally infer, via pragmatic enrichment, that the speaker is suggesting that s/he eats the biscuits.

[5]The paraphrase *what if* α*?* is just a shortcut to illustrate the discourse inquiry and it may not be always suitable. We abstract away from additional meanings triggered by the utterance of these questions.

[6]The question established by the antecedent is rather vague, but in providing the answer, the speaker provides enough for the addressee to make out what the goal of the question is.

One prediction from this proposal is that the pragmatic inferences triggered in *if*-constructions are the same as the ones found in question-answer pairs. This prediction is borne out. (That the conditional form is congruent in giving rise to the same inferences as the distributed fragments had already been observed in Starr 2014: 18.[7])

(13) A: What if I get hungry?
B: There are biscuits on the sideboard.
$\rightsquigarrow$ I suggest that you eat the biscuits.

B's utterance in (13) is interpreted as providing an answer to A's question. Assuming that participants are cooperative, the response leads to the interpretation that A is allowed to eat the biscuits. Note also that unless it is done immediately the inference triggered via relevance in this case cannot be cancelled and becomes part of the common ground.[8]

In each of these cases, the inference is a result of a process of pragmatic enrichment derived by the same mechanisms that are at work in pragmatic enrichment generally. An example is given in (14) where the addressee A infers by pragmatic enrichment that B wants to bring across that it is very late.

(14) A and B are attending a party together and have been there for a while.
A: What time is it?
B: Most people already left.
$\rightsquigarrow$ It's very late

We won't get into the matter of how the mechanism of pragmatic enrichment works exactly (see e.g. Benz 2012 for a proposal). Rather, our point is to argue that an utterance of a BC leads to a triggering of such inferences in the same way as other discourse-relevance inferences are derived (where relevance is as defined in 2).

The proposal can also explain Sano and Hara's (2014) empirical observation that BCs like (15) are (almost always) judged infelicitous. As predicted in our theory, the same is found with the corresponding question-answer pair:

(15) If France is hexagonal, there is beer in the fridge.

(16) A: What if France is hexagonal?
B: There is beer in the fridge.

[7]There are several differences between Starr's (2014) proposals and the one in this paper. Most importantly, Starr establishes in the semantics of the *if*-constructions that the antecedent signals the question being addressed. It is not clear to us whether his proposal can be modified to allow for the required flexibility in the mapping between *if*-constructions and discourse argued for above.

[8]While we have no space to address all BCs, our proposal can also handle *discourse hedging* BCs such as *if you want to hear a big fat lie, George W. and Condi Rice are secretly married.* The QUD inquires 'what do the worlds in which the speaker tells a big fat lie look like?'. The response is that these are worlds in which the addressee says that George and Condi are secretly married. More, certainly, needs to be said about these cases and their apparently special behavior (see Csipak 2015). The reader is referred to Biezma and Goebel (2017) for discussion within the framework presented in this paper.

Our proposal allows us to predict that these BCs and the parallel question-answer pair will be bad unless the participants can come up with an explanation as to why the consequent is relevant to the QUD. There are in fact contexts in which (15) and (16) are good. Imagine a context in which a couple of friends are making a bet regarding the shape of France. While one thinks it's hexagonal, the other thinks it's a square. When clarifying what's at stake, the speaker betting for the square shape can felicitously utter (15), or respond to the question as in (16), to establish what the addressee will win were the shape be hexagonal.

Our proposal also applies to HCs and intuitions regarding 'causality'. The mapping from *if*-constructions to discourse we have been exploring for BCs is also possible for HCs (although HCs also can have the reverse one). The difference is that when interpreting the relation between question and answer in a HC via relevance, we can recover a dependence relation between the two propositions:

(17) If you are hungry, I'll make you some sandwiches.
QUD: What if I'm hungry?
Response: I'll make you some sandwiches.

In a scenario in which it is conceivable that sandwiches wouldn't necessarily be made and that the making of the sandwiches can be dependent on someone's hunger, we can draw the inference that the addressee being hungry is what 'causes' / 'leads to' the making of the sandwiches (the intuition being that if the addressee is not hungry, the sandwiches won't be made). The intuition that there is a dependence between the antecedent and consequent proposition can be taken to respond to the mapping of *if*-constructions into discourse and the need to satisfy relevance. When there is no plausible dependence relation between antecedent and consequent, the inference of causality does not arise.[9]

[9]Ippolito (2016) also considers the mapping of BCs into discourse and their differences in interpretation with HCs in a short note on relevance conditionals, although her overall proposal is rather different. Ippolito (2016) proposes that conditionals (what we carefully term *if*-constructions) of the form *if* ϕ, ψ address a 'conditional question' of the form *if* ϕ, Q?, where ψ is a possible answer to Q. The BC in (1b), for example, is taken to address an ongoing QUD that can be paraphrased by 'If you are hungry, is there anything to eat?'. The BC addresses this question by offering the 'premise' in the consequent that, indirectly, answers it. It is not clear to us how this question is identified in Ippolito's system, i.e. what are the conventional cues in the information structure of the utterance identifying that such is the inquiry being addressed, which is essential within the QUD model. In addition, given the arbitrary choice of question, it is not clear to us how this system would account for cases of 'classic' conditional perfection like (10), or cases of 'biscuit perfection' (see §4), which are explained by assuming a mapping to discourse that does not involve conditional questions but a classic information-structural division of labor between antecedent and consequent like the one explained above and adopted in this paper. In addition, Ippolito (2016: 56) also aims to offer and explanation as to why some *if*-constructions have a 'causal' interpretations while others don't: "The proposal that I would like to make is that the difference between causal and non causal counterfactuals lies in their relation to the [QUD]. A causal counterfactual answers the [QUD] *directly*, whereas a non-causal counterfactual answers de [QUD] *indirectly* by spelling out a premise assuming which the [QUD] is then answered." In our system, causality is also an inference, but it does not result from the utterance providing a direct answer. In our account, that the HC is taken to provide a *direct* answer to a QUD is the byproduct of there being a dependence relation between antecedent and consequent.

Overall, Ippolito (2016) is not devoted to BCs but aims to explain how context dependence allows us to identify the premises relevant in the interpretation of counterfactuals. We leave for future research the evaluation of her claims once we adopt a mapping between *if*-constructions and discourse that considers their information structure.

In sum, BCs are merely *if*-constructions in which we understand that antecedent and consequent are independent. This is a possibility for *if*-constructions and can be reinforced through linguistic means. For example, many stereotypical examples of BCs involve stative predicates. This is not accidental. With stative predicates it can be easier (though not necessary) to interpret that the antecedent and consequent temporally overlap, without a causal dependency. On the other hand, linguistic means can block the independent interpretation. Following Biezma (2014), the presence of the discourse maker *then* prevents a BC-reading since it conventionally requires that two propositions (antecedent and consequent) enter into a 'causal explanatory claim'-relation in which one (the antecedent) provides the 'reasons' for the other (the consequent) and causality is not cancellable anymore (but see discussion on *then* in §5).[10]

Let us finish this section with a discussion of why the reverse discourse-mapping for *if*- constructions, one in which the antecedent provides the answer to a question signaled by the consequent, is not available for BCs. According to the (rough) semantics of *if*-constructions adopted in this paper, the QUD for such a mapping would be *what are the propositions such that for all 'relevant' worlds in which those propositions are true, the consequent is true?* We can paraphrase this inquiry with the question *When q?*,[11] and this is indeed what we take the question to be in the 'regular' perfect conditional in (10). We illustrate this mapping for BCs in (18):

(18) QUD: When are there biscuits on the sideboard?
Response: If you are hungry (there are biscuits on the sideboard).

A BC is not a felicitous answer to this QUD and a mapping of the BC to this discourse structure is ruled out. Given the QUD in (18), it is relevant whether or not all circumstances are such that there are biscuits on the sideboard, and, if not all, in which. The BC leads to an answer (in all of them) but only indirectly as a result of the BC-strengthening process. It also provides extra information that is not requested (i.e. that, in particular, the worlds in which you are hungry are worlds in which there are biscuits on the sideboard). One way to explain the infelicity is using the economy principle in Romero and Han (2004).[12]

We have claimed that considering how BCs map into discourse can explain several properties of BCs. In the following section we argue that the proposed mapping is necessary independently to explain biscuit perfection.

4. Biscuit perfection

We have seen above that some BCs can give rise to inferences such as suggestions. As we have noted in §1, however, there is a contrast between (19) and (20) ('$\rightsquigarrow$' signals any non-

[10]Obviously this is derived from the original temporal meaning of *then*: when found coordinating two events it requires that the two take place sequentially.

[11]The same caveat as above holds for this rough paraphrase, i.e. the topical question is not to be confused with proper utterance of this specific interrogative. This is merely a shortcut to illustrate the discourse inquiry.

[12]The principle of economy prevents the use of meta-conversational moves unless they are necessary to resolve epistemic conflicts or to ensure Quality.

conventional meaning):[13]

(19) Oh, you are making pasta bolognese!
If you need wine for the sauce… there is a bottle by the microwave.
(L)-H* (on *wine*) L+H* L-H% (on *sauce*)
$\rightsquigarrow$ There is a bottle of wine by the microwave [BC strengthening]
$\rightsquigarrow$ I suggest that you use the wine by the microwave. [Discourse relevance]
$\not\rightsquigarrow$ I only suggest that you use the wine by the microwave if it is for the sauce.

(20) Oh, you are making pasta bolognese!
If you need wine for the sauce… there is a bottle by the microwave.
L+H* L-H% (on *sauce*)
$\rightsquigarrow$ There is a bottle of wine by the microwave [BC strengthening]
$\rightsquigarrow$ I suggest that you use the wine by the microwave. [Discourse relevance]
$\rightsquigarrow$ I only suggest that you use the wine by the microwave if it is for the sauce. [?]

We will now focus on (20). As we have noted earlier, a speaker uttering the BC in (20) provides information regarding what wine to use for the sauce while explicitly signalling that there are other circumstances in which wine may be needed that s/he is not addressing (contrary to what happens with (19)). In this sense, the BC in (20) is explicit about the fact that it offers only a partial resolution to a question regarding what wine is to be used when. This results in the inference that the use of the wine by the microwave is only a suggestion for the making of the sauce and nothing else, i.e. the suggestion-inference is strengthened. This is what we have called *biscuit perfection*. How can we derive this strengthened inference? In what follows we argue that it results from the specific details of the mapping of (20) into discourse.

Our proposal is that the strengthened reading results from mapping the BC in (20) to the D-tree in (21):

(21)
- What use has what wine?
  - What wine do I use if I need it for the sauce?
    - If you… there is a bottle by the microwave
  - What wine do I use if I need to drink a glass?
  - …

Given this D-tree, the QUD addressed by the BC is part of a larger strategy to answer a complex question. With this mapping, the speaker has clearly marked that s/he is addressing a specific (sub-)question and not others contextually salient that contrast with it. Given that the speaker was careful to signal that this answer was not provided with respect to any other salient question, the resulting inference is that the suggestion to use the wine by the microwave is only made if it is for the purpose of making the sauce. The question now is: why does (20) map into a D-tree like (21) while (19) doesn't?

[13] Notice that even though the shape of the complex accent is the same, the height of the pitch is different. In a pilot study the H* in *sauce* is much higher ($\simeq$ 290Hz) in the perfected version, (20), than in the non-perfected one in (19) ($\simeq$250Hz). Also, the high pitch on wine is $\simeq$365Hz in (19) whereas it only receives a pre-nuclear accent at best in (20). We are very grateful to Anja Arnhold and Marc Brunelle for their help discussing the prosodic data.

Our proposal is that the mapping of (20) into the D-tree in (21) depends on conventional linguistic devices that give rise to such a mapping. In this case, it is prosody that is (conventionally) responsible (but see below for additional mechanisms).[14] In what follows we argue that the phenomenon of biscuit perfection is nothing more than contrastive topic (CT) marking in BCs. The discussion revolves mostly around BCs because this data is used in this paper as an argument in favor of a pragmatic account of BCs. However, notice that similar phenomena can be observed in HCs, with the only difference that the inference that is perfected in HCs concerns causality. At the end of the day, the claim is that 'inference perfection' via linguistic marking in *if*-constructions is nothing more than contrastive topic in *if*-constructions.

In what follows we sketch Constant's (2014) proposal for CT and examine a straight-forward application of this account to conditionals. We close the section with a discussion of the fact that CT-marking in *if*-constructions seems to be more complicated than it is taken to be in Constant (2014). The discussion serves the purpose of showing how *if*-constructions can serve as probes to broaden our understanding of CT-marking in English.

4.1. A theory of Contrastive Topic and BCs

We adopt Constant's (2014) theory of CT (see references therein for other accounts and discussion). In this section, we sketch Constant's (2014) proposal and examine its application to BCs. As we will see, CTs provide the crucial insight to understand biscuit perfection.

The phenomenon of CT in simple sentences is illustrated in (22) (adapted from Constant 2014):

(22) I arrive late to a potluck party and I am not aware of who brought what. I have asked another guest to fill me in on the details. A few minutes into the conversation, the next exchange takes place:
A: What about Persephone and Antonio? What did *they* bring?
B: PERSEPHONE... brought the GAZPACHO.
L+H* L-H% H* L-L%
Antonio, I'm not sure about.

As Constant puts it, by using these specific prosodic features B indicates that he has decided to break the asked question in two smaller pieces, one about Persephone and one about Antonio. In a way, Persephone and Antonio become "*topics* of smaller issues, and they *contrast*" (Persephone is the contrastive topic). In addition to indicating that the question is now split in two parts, the speaker provides an exhaustive answer regarding what Persephone brought, this is the constituent *the gazpacho*. (The constituent that provides the exhaustive answer is the exhaustive focus.) A paraphrase could be as follows: "As for the issue of Persephone, the answer to the question of what she brought is the gazpacho." The claim in the literature is that there is a systematic relationship between the surface realization of B's response and the discourse role of its constituents, so we can predict one from the other. In Constant (2014), contrastive topic is an information-structural category indicating the question that is being answered. Regarding

[14]Notice that not all BCs trigger extra inferences such as suggestions and hence not all biscuits can perfect via conventional mechanisms such as the use of prosody. See discussion in §4.2 below.

the interpretation, CT-marking is merely focus marking (it evokes alternatives à la Rooth as any other focus marking) with additional information of how the focus alternatives are used in the semantic computation. The instructions regarding how to manipulate the generated alternatives are cashed out in the CT-operator indicated in English by a special intonation, the complex contour L+H* L-H%. The CT constituent is "a F-marked phrase in a particular structural position, or bound by a particular focus-sensitive operator" (Constant, 2014: 85). This proposal can be seen as belonging to a family of configurational approaches, "[a theory that tries] to establish what configuration defines a focus as CT, and to model how this configuration is spelled out in surface syntax and phonology" (see Constant 2014 for discussion).

The mapping between utterances and discourse is done via focus anaphora in the Roothian tradition: focus structure helps identify the question in discourse that the utterance is answering. This is done via the familiar '$\sim$' operator with a slight modification to relax the membership relation in (23ciii) (see Constant 2014 for discussion). The '$\sim$' introduces the presupposition that there is a discourse antecedent that is a question of a particular shape:

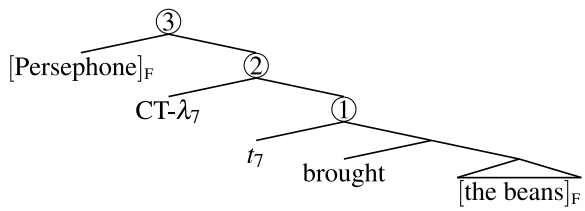
(23) Constant's (2014) '$\sim$'
a. $[\![\sim \phi]\!]^o = [\![\phi]\!]^o$
b. $[\![\sim \phi]\!]^f = \{ [\![\phi]\!]^o \}$
c. ... and presupposes that the context contain an antecedent C such that:
(i) $C \subseteq [\![\phi]\!]^f$
(ii) $|C| > 1$
(iii) $[\![\phi]\!]^o \,{}^*\!\!\in C$ "C contains $[\![\phi]\!]^o$ somewhere within it."

The other addition to the system is the mechanism that combines the focus alternatives in utterances with CT-marking. This is done via the CT-operator, with CT-hood linked in English to the complex contour L+H* L-H% that we find in standard CT-constructions:[15]

(24) **Topic abstraction**
a. $[\![\text{CT-}\lambda_i\ \phi]\!]^o_g = \lambda x.\ [\![\phi]\!]^o_{g[i \to x]}$ (Ordinary semantic value)
b. $[\![\text{CT-}\lambda_i\ \phi]\!]^f_g = \{\lambda x.\ [\![\phi]\!]^f_{g[i \to x]}\}$ (Focus semantic value)

The ordinary semantic value of CT-λ is merely predicate abstraction, but at the focus value provides us with the expected result. Following Constant, let us look at the structure of the CT-utterance in (22):

(25) $[\![[\text{Persephone}]_F \text{ brought } [\text{the beans}]_F]\!]^f_g$



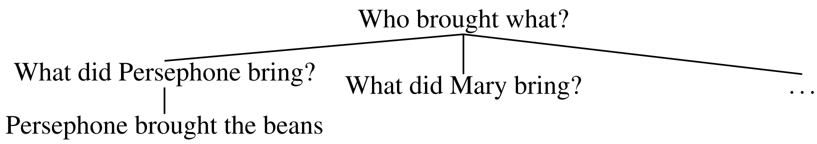
[15]Constant (2014) considers that the complex pitch accent could also adopt other forms, such as H* or L*+H.

a. $[\![①]\!]^f_g = \{g(7) \text{ brought the beans}, g(7) \text{ brought the pasta} \ldots\}$
b. $[\![②]\!]^f = \{\lambda x.\{g(7) \text{ brought the beans}, g(7) \text{ brought the pasta} \ldots\}\}$
c. $[\![③]\!]^f = \left\{ \begin{array}{l} \{\text{Persephone brought the beans, Persephone brought the pasta, } \ldots\}, \\ \{\text{Mary brought the beans, Mary brought the pasta, } \ldots\}, \\ \ldots \end{array} \right\}$

CT here involves left-dislocation of the contrastive topic constituent, justifying predicate abstraction and the CT-operator. Topic-abstracting the subject helps to create a nested focus value containing a set of questions varying in the position of *Persephone*. The resulting focus value is a complex question sorted by the topic-abstracted argument (*who brought what?*).[16] This focus value is the input of the squiggle operator enforcing the congruence that derives the interpretation of utterances with CT:

(26) $[\![\sim [[\text{Persephone}]_F\ CT\text{-}\lambda_7\ \ t_7 \text{ brought } [\text{the beans}]_F]]\!]^f = \{\text{Persephone brought the beans}\}$ felicitous iff there is a question in discourse made up of multiple questions of the form "What did x bring?", one of which is the question "What did Persephone bring?".

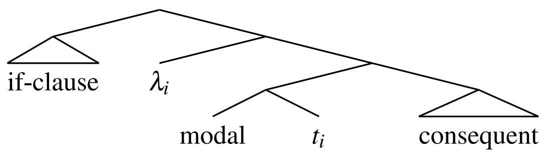
That is, the utterance of *Persephone brought the beans* with the CT-marking in (22) is felicitous in a discourse structure like (27):

(27)


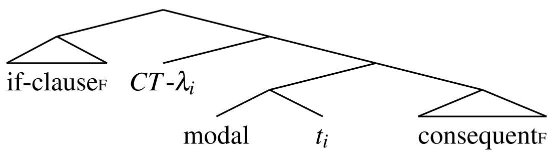
The structure in (27) is exactly like the one we want to derive in (21). We propose that in both cases, CTs provide the key to understanding how the D-tress are generated. The question is whether we can merely adopt Constant's (2014) proposal to explain biscuit perfection. The answer is yes, mostly. We turn to the straight-forward application of Constant's (2014) proposal below and discuss some problems in §4.2.

Following much of the literature (see Bhatt and Pancheva 2006 for discussion), we take it that *if*-clauses are correlative/free-relative adjuncts and assume the syntax in (28a). In *if*-constructions we do not need to assume movement of the topic-constituent. We have binding of the restrictor to the modal in the matrix clause being interpreted via predicate abstraction. With CT-marking we get the CT-operator and not just mere predicate abstraction, (28b).

(28) a. Conditionals as correlatives



b. Conditionals as correlatives with CT-marking



The interpretation of the utterance in (20), unlike the utterance in (19), is then as follows:[17]

[16]This assumes that questions denote sets of propositions, specifically, their possible answers (Hamblin 1973).
[17]Strictly speaking, focus marking is on *sauce* (see (20)). This is what evokes alternatives to the antecedent.

(29) [[If you need wine for the sauce]$_F$ CT-λ_9 [t_9 there is a bottle by the microwave]$_F$]

(30) $[\![\sim(29)]\!]^f = \{$If you need wine for the sauce there is a bottle by the microwave$\}$ felicitous iff there is a question in discourse made up of multiple questions of the form "What if the addressee needs wine for *x*?", one of which is the question "What if the addressee needs wine for the sauce?".

At the core of CT is partial answerhood. In contrast with (20), in (19) we do not convey (linguistically) that there are contrasting alternatives that the speaker is not answering, hence do not mark conventionally that the utterance is embedded in a D-tree like (27).

To summarize, we have seen above that 'biscuit perfection' and in general conventional strengthening of the inferences in *if*-constructions is just CT-marking in *if*-constructions and can be explained by using mechanisms argued for independently of conditionals. Crucially, these mechanisms result in a mapping of BCs to discourse that explains the inferences in BCs and the effect of biscuit perfection. No special BC-specific semantics needs to be invoked.

4.2. Shedding light on CT-marking in English

Constant (2014) also discusses the case of conditionals and their mapping in discourse. The claim is that conditionals "generally make good CT" , but Constant explicitly excludes BCs and factual conditionals (without considering that there are biscuits that are factual) and, hence, only (non-factual) HCs are taken to be able to encode CT. The reason, he states, is that "the antecedent of a HC makes good contrastive topics, since considering one hypothetical possibility almost inevitably leads to questions about contrasting possibilities[...] Non-hypothetical conditionals, on the other hand, do not typically set-up contrasts with different antecedents" (Constant, 2014: 321).[18] He provides the following prosodic characterization of a conditional with a CT-reading. (Constant 2014 does not provide prosodic annotation for BCs):[19]

(31) If it's $\underset{\text{L+H* L-H\%}}{\text{RAINING...}}$ we'll have to cancel the $\underset{\text{H* L-L\%}}{\text{PICNIC.}}$ (Constant, 2014: 285)

According to Constant, it is the interpretation of factual conditionals and BCs what prevents them from being interpreted as conveying CT: to a non-factual HC like (31) one can respond with "And if it doesn't rain?", but that is not a possible response to the former merely because either other alternatives to the antecedent are already discarded (in factual conditionals the antecedent is taken to be true) or because the consequent is taken to be true across the board (in BCs). However, while it is true that questions about what is the case in circumstances other than the ones established in the antecedent are impossible in factual conditionals and BCs, one can ask about the inferences triggered by the utterance of a BC (if there are any). For example, given

[18]Constant's discussion of conditionals aims to explain the contrast between *if*-constructions and *because*-clauses. In both cases we find the prosodic markings tied to CT-interpretations, i.e. L+H* L-H%, but *because*-clauses do not have a CT-interpretation. His conclusion is that not all L-H% in English convesys CT: "while sentence final L-H% is robustly interpreted as CT, non-final L-H% is unreliable in this regard".

[19]We take it from the discussion that he assumes this to be the default intonation for HCs.

an utterance of (2b), one could ask "And if I want to pour myself a glass? (does the suggestion still hold? shall I use the same wine?)" Notice that when a BC doesn't trigger extra-inferences, such as in (7) (or at least these are harder to grasp), no question of this sort is possible and there, in fact, we do not (easily) get a CT interpretation.

Several questions arise at this point pertaining to CT-marking in conditionals and CT-marking in general. Given that (2b) does have a CT-reading while (2a) doesn't, and both have L+H* L-H% marking, it seems that it is not this specific complex contour what is responsible for the CT-reading in conditionals. The data suggests that what delivers the CT-reading is merely the marking of contrast in the constituent that is understood as establishing the QUD (the antecedent): this happens in (2b) by de-accenting everything else but one word, while in (2a) there are two words that receive H* or L+H*.[20] In *if*-constructions, L-H% is merely a continuation tone. This is also true for non-factual HCs.[21] The general claim is that the CT-reading appears in *if*-constructions when we understand that there are salient alternative questions to the one being addressed and that they won't get necessarily the same answer. We can enforce this reading conventionally by using specific prosody, or by other means that indicate that the speaker is answering only a particular question amongst a contextually salient set (the others remain un-answered). An illustration is provided in (32). The presence of *only/just* in (32) ensures that the use of wine the speaker is talking about contrasts with others.

(32) Well, if you only/just need the wine for the sauce, there is a bottle by the microwave.

A CT-type interpretation can also arise in BCs without any linguistic marking as an inference from world-knowledge. In (33), it is world-knowledge what tells us that the suggestion/permission regarding killing people is tied to people turning into zombies.

(33) A virus is transforming people into zombies. A farmer in an area suspected of infection tells his farm workers:
Farmer: If the virus breaks out, the rifles are in the safe.

It is understood that if the virus does not break out, shooting of people should not happen, i.e. we understand that there are contextually salient alternatives to the antecedent for which the answer wouldn't be the same, leading to a CT-type interpretation without CT-marking.

The conclusion is that CT-marking is not necessarily done prosodically via the complex L+H* L-H% contour. When the information structure of the sentence already establishes what is the

[20]More work needs to be done regarding the prosody of BCs. Notice however that marking contrast in *rained* in (7), where no extra-inference can arise, doesn't seem to be felicitous. The explanation would be that the enforced discourse structure doesn't have a plausible interpretation.

[21]As mentioned above, HCs often perfect. Constant (2014) argues that this is due to the prosodic marking L+H* L-H%, but just as in the case of BCs this specific prosodic marking does not convey CT in conditionals. We do not have space to provide a fair discussion on the matter, but we would like to argue that the CT-type interpretation that often arises in HCs is an inference resulting from there being a dependence relation between antecedent and consequent, together with the fact that the speaker has decided to make a claim about only a subset of *c*. This inference, hence, arises via world-knowledge and (Gricean-) reasoning about why the claim was only made about a subdomain. However, this interpretation can also be enforced with specific prosodic marking (as discussed in ftn. 13) or other means (see below), all CT-marking, and in this case the interpretation is not an inference anymore.

QUD being addressed, marking that there are other contrasting questions that are not being addressed with other prosodic means (see ftn. 13), or lexically, is a type of CT-marking (i.e. it conventionally derives a CT-type reading). Research in this direction is left for the future.

5. Comparing theories

One question that remains to be addressed is whether the resulting theory of BCs is superior to semantic theories of BCs. While we cannot draw here a full comparison, we will conclude this paper by pointing to some advantages that this theory has over semantic approaches.

The first point is that in order to explain perfect biscuits, semantic theories would actually have to appeal to mechanisms similar to the ones proposed here in addition to stipulating that the semantics of BCs is different from that of HCs. For the remainder of this section, let us take Ebert et al.'s (2014) proposal (henceforth EEH) as a point of comparison, since this is a recent sophisticated semantic proposal and it covers the largest range of data. In EEH's proposal, all *if*-constructions introduce two speech acts: the antecedent introduces a referential speech act (identifying a maximal plurality of possible worlds compatible with the world of evaluation, X), and the consequent introduces another speech act. HCs are *if*-constructions in which the consequent is evaluated in the worlds identified by the antecedent, (34a). In BCs the consequent is evaluated in the actual world and there is no interpretational link with the antecedent (34b):

(34) EEH's analysis of conditionals applied to the contrast between (1a) and (1b) above:

a. HCs (aboutness topicality) If you are hungry, I'll give you some biscuits:
$\text{REF}_x(w_0.\lambda w'.M_{w'}(\lambda w.\text{hungry}(w)(\text{listener})))$ & $\text{ASSERT}(X, \lambda w.\text{give\_you\_some\_biscuits}(w))$

b. BCs (relevance topicality) If you are hungry, there are biscuits on the sideboard:
$\text{REF}_x(w_0.\lambda w'.M_{w'}(\lambda w.\text{hungry}(w)(\text{listener})))$ & $\text{ASSERT}(w_0, \lambda w.\text{biscuits\_on\_sideboard}(w))$

Where $M_{w'}(p) \underset{\text{def}}{=} \sigma(\lambda w.p(w) \wedge R_{ep}(w')(w))$ and $R_{ep}(w')(w)$ is the set of worlds epistemically compatible with w';
$\text{ASSERT}(w, p_{\langle s,t\rangle}) \equiv$ the speaker commits herself to the truth of p in w
$\text{REF}_X(w, d_{\langle s,\sigma\rangle}) \equiv$ the speaker draws the listener's attention to $d(w)$

EEH capitalize on the claim often repeated in the literature that *then* is not possible in BCs. Adopting a correlative account of conditionals, they take *then* to be a proform that when present at LF (if covertly) forces the consequent to be interpreted in the antecedent worlds delivering the HC-reading. The LF in BCs does not have *then*. Differences between HCs and BCs result from different LFs. We discuss this proposal below, pointing to problematic issues.

1. Then *is possible in* BCs*!*

When naive speakers of English are asked about (35), they often accept it without hesitation:

(35) If you are hungry, then there are biscuits on the sideboard.

The paraphrase that is given is that "given the possibility that you are hungry, I'm telling you that there are biscuits on the sideboard". The reading that biscuits will magically appear upon your being hungry could also be conveyed by uttering (35), but given our knowledge of how the world works (the dependence relations), this reading is discarded because of its implausibility. It is possible if our assumptions about *dependencies* change (e.g. if the sentence is uttered in a movie involving a magical world). Another example is provided in (36), judged to be perfect:

(36) If you want to know my opinion, then I think you are making a mistake marrying him.

Again, (36) has two readings, one in which my thinking of you making a mistake is caused by your will to know my opinion, a HC-reading, and one in which my telling you what I think (which is that you are making a mistake) is the result of you wanting to know it. This last reading is still a BC in our account (since for an *if*-construction to be a BC it is the relation between the propositional content of antecedent and consequent what has to be independent).

That *then* is possible in BCs is a problem for EEH's account, since we now lack support for the proposal that there are two different LFs responsible for the two different readings. What *then* does can be explained in a theory along the lines of Biezma (2014) where *then* is a discourse marker that enforces a causal explanatory relation between an antecedent and a consequent. Crucially, in Biezma (2014) there is enough freedom to allow the fact that a particular move was made to be the content manipulated by *then* (see Biezma 2014). The different readings described above depend on the choice of content targeted by *then*.

2. *If they ask you how old you are, you are four*

BCs like 2 are handled very easily with the theory proposed here:

(37) In a bus, the father doesn't want to pay his kid's fare. Knowing that kids under five ride for free he says:
Father: If they ask you how old you are, you are four.

The interpretations of this BC is that the speaker is requesting the addressee to lie (which would be derived as a relevance inference in our proposal). Notice, however, that the speaker does not mean for the addressee to go right away to the ticket collector and tell him that he is four (which would, for example, be the interpretation derived in EEH, in which the consequent is headed by a command speech act regardless of the fact that the clause is a declarative).[22] BCs providing a command always perfect, and this is so because commands are always tied to specific circumstances and hence, to the circumstances specified in the *if*-clause. Our knowledge of commands and their dependence on the circumstances allows us to understand that when the circumstances in the antecedent are not met, the command doesn't apply. The consequent in 2 is a declarative, but this can be shown with an imperative too: *...tell them you are four*.[23] Obviously this anchoring to the circumstances does not arise when the imperative conveys dis-

[22]Note that EEH end up needing to postulate a number of rather idiosyncratic speech acts that raise questions about the predictive power of the account, such as "not run of the mill assertions", invoked in EEH(:361) to explain the interpretation of the consequent in *if you want to hear a big fat lie, George W. and Condi Rice are secretly married* (the consequent is understood here as being claimed to be false).

[23]This wouldn't be a BC in our account. The semantics of the imperative form can be taken to be either the content proposition or a deontic statement, and in this case it obviously depends here on the truth of the antecedent.

interested wishes or when using equivalent modal statements:

(38) If I don't see you before you leave, have a good trip!! / I wish you a good trip.

By uttering (38) I am not saying that I desire you to have a good trip only if I don't see you before you leave. Crucially, it is due to our understanding of how disinterested wishes work that we understand that in any circumstances alternative to those expressed in the antecedent, you desire the addressee a good trip.

3. *Encoding the mapping into discourse in the semantics is not a good idea*

Ebert et al. (2014) propose that we can understand the referential speech act in conditionals as identifying the QUD in discourse. However, this means encoding the mapping of conditionals to discourse in the semantics. As we have seen above, any theory that forces a unique mapping of conditionals to discourse runs into problems to explain cases in which the mapping has to be the opposite, as in classic conditional perfection illustrated in (10).

6. Conclusion

Taking into account discourse congruence and relevance, BCs are revealed as examples of the flexible set of strategies we deploy in the construction of meaning, requiring no departure from the semantics of other conditionals. Furthermore, BCs and perfect-BCs show that the interplay between semantic meaning and considerations regarding discourse-structure, as well as information gained in discourse reasoning, are crucial in the construction of meaning.

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Reportative deontic modality in English and German[1]

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Abstract. We discuss the dual uses of the English adjectival modal *be supposed to* and the German modal auxiliary *sollen* under their deontic and evidential readings. While deontic modality is a familiar category, we discuss novel data on the expression of reportative evidentiality in English. We argue for a truly unified analysis for both *be supposed to* and *sollen*, which are specified for a reportative informational conversational background. The apparent difference in "flavours" (reportative vs. deontic) is an illusion, caused by differences in the types of reports that feed the ordering source. Although we assign *be supposed to* and *sollen* an identical semantics, their distributions are not identical. We hypothesize that this is due to the fact that in German, *sollen* competes with the quotative modal *wollen*, which carries a stronger presupposition, triggering Maximize Presupposition effects which are absent in English.

Keywords: modality, deontic, reportative, *be supposed to*, *sollen*, *wollen*

1. Introduction

In this paper, we discuss the dual uses of the English adjectival modal construction *be supposed to* and the German modal auxiliary *sollen*. In both languages, these modal expressions display both deontic and evidential readings. Specifically, the evidential reading has a reportative flavour, whereby the source of evidence for a claim is a prior report. As shown in (1), sentences containing *be supposed to* and *sollen* are compatible with contexts favouring either a deontic or reportative interpretation.

(1) **Deontic context:** A student asks the department administrator when Professor Plum will be in the office. The university's rules state that professors must have office hours between 10-11am every day. The administrator says:
Reportative context: A student asks the department administrator when Professor Plum will be in the office. Earlier that day, Professor Plum's partner called the administrator and said that they are running late but will come in at 10am. The administrator says:
a. Professor Plum **is supposed to** be here at 10.
b. Professor Plum **soll** um 10 hier sein.
Professor Plum SOLL at 10 here be

While the reportative use of *sollen* has received some attention in the literature (Faller, 2006, 2012; Hinterwimmer, 2013; Kratzer, 1981, 2012; Schenner, 2008), we show here that reportative evidentiality is also lexicalized in English in *be supposed to*. This observation complements the work of von Fintel and Gillies (2010), who argue that the epistemic modal *must* in English

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lexicalizes an indirect inferential evidential component.

Furthermore, although deontic modality is a familiar category, we show that the deontic flavour of these modal expressions is narrower than the deontic uses of *must* or *have to*. Specifically, *be supposed to* and *sollen* cannot be used performatively, i.e., they can only describe obligations that already exist, and cannot be used to place new obligations. We make use of this fact to argue for a unified analysis of the reportative and deontic uses of these modals. Specifically, we reduce the deontic use to the reportative one, arguing that these apparently different "flavours" are both derived from a circumstantial modal base and a reportative informational ordering source within a Kratzerian framework. We furthermore argue that our account fares better than recent analyses for *sollen* invoking intentional acts (Hinterwimmer, 2013) or external bouletic ordering sources (Matthewson and Truckenbrodt, 2017).

This paper proceeds as follows. We first discuss the deontic use of *be supposed to* and *sollen* in section 2. Section 3 discusses the reportative use. We present our unified analysis for both uses in section 4. Section 5 focuses on German *sollen* and its competitor, the reportative modal *wollen*, while section 6 discusses previous accounts. Section 7 concludes.

2. Non-performative deontic use

We first discuss the deontic use of *be supposed to* and *sollen* in more detail, as already shown in (1). Like other deontic modals, these can be used in different contexts to convey different flavours of deontic necessities. For instance in (2) they can be used to talk about laws, while in (3) they are used to talk about rules.

(2) Context: Your friend has just parked in front of a fire hydrant. You say:
a. You're not **supposed to** park there.
b. Du **sollst** hier nicht parken.
you SOLL here not park (reports a law)

(3) Context: Your friend has just landed on a community chest in Monopoly. You say:
a. You're **supposed to** pick up a card.
b. Du **sollst** eine Karte nehmen.
you SOLL a card take (reports a rule)

However, an important feature of *be supposed to* and *sollen* is that they cannot be used performatively. Rather, they can only be used to report on existing laws or rules. This can be shown in (4), where the context provides that the rules of the game Calvinball are not pre-determined, but made up on the spot. In such a context, *be supposed to* and *sollen* cannot be used, whereas other deontic modals such as *must*, *have to* or *müssen* 'must' can be.

(4) Context: You are playing Calvinball, a game where the rules are made up on the spot, and no rule can be re-used. The players shout out the rules as they make them up.
a. Now you {**have to/must/#are supposed to**} throw the ball across the field.
b. Jetzt {**musst/#sollst**} du den Ball über das Feld werfen.
now must/SOLL you the ball across the field throw

(*Calvin and Hobbes*, Bill Watterson, originally published 26.08.1990)

Note that the problem with (4) is not that the speaker is the source of the rule. As shown in (5) and (6), the speaker can serve as the deontic authority.

(5) Context: Parent to child:
  a. You're **supposed to** go to bed by 9pm.
  b. Du **sollst** um 9 im Bett sein.
     you SOLL at 9 in.the bed be

(6) Context: The speaker made a New Year's resolution to smoke less this year. On January 2, she is offered a cigarette.
  a. I'm **supposed to** smoke less this year.
  b. Ich **soll** dieses Jahr weniger rauchen.
     I SOLL this year less smoke

Lauer (2015) discusses "anti-performative" modals, and argues that the restrictions on performativitiy can be derived from the temporal profile of such expressions. Lauer argues that anti-performative modals are simple stative predicates. Like other statives, they are required to be true throughout the reference time interval. In the case of present-tense modals, this means the modal statement is required to be true throughout the speech time. We can schematize this restriction in the case of *be supposed to* and *sollen* as in (7). In prose: for all moments m contained within the speech time $\tau(u)$, it is necessary at m that p.

(7) $[\![\textit{be supposed to/sollen}(p)]\!]^u = 1 \textit{ iff } \forall m \in \tau(u) : \Box_m(p)$ (sketch)

Performativity clashes with these temporal requirements on stative modals. Intuitively, an event of imposing an obligation will result in a state of an obligation holding. Let us assume with Lauer that if a state s is the result of an event e, then s will not obtain before the final moment of $\tau(e)$. It follows then, that if an obligation is created as a result of uttering a modal sentence, then a present tense stative modal statement will never be true at speech time, since the condition in (7) that the requirement that p hold throughout the speech time would be violated. Following this chain of reasoning, for a sentence containing present tense *be supposed to* or *sollen* to be true, it must be the case that the obligation already exists before the speech time. A performative use of these modals is thus ruled out.[2]

The upshot of this discussion is that although *be supposed to* and *sollen* can take on a deontic flavour, they behave differently from other deontic modals in being anti-performative. That is, they require a preceding event that brings the obligation into existence. We now turn to describe the reportative use in more detail, which also requires an antecedent event, namely a report.

3. Reportative use

Cross-linguistic research in the last decade or so has shown that modals can encode a speaker's evidence type, and in some languages, evidence type restrictions are grammaticalized in evidential modals (e.g., Faller 2012; Matthewson et al. 2007). Even for English, it has been argued by von Fintel and Gillies (2010) that epistemic *must* lexicalizes an inferential evidential component. Whereas the reportative use of *sollen* has been discussed in the literature already (e.g., Faller 2006, 2012; Hinterwimmer 2013; Kratzer 1981, 2012; Schenner 2008), we add here novel data from English that the modal construction *be supposed to* also has a reportative use, cf. (1).

Adapting the diagnostics from von Fintel and Gillies (2010), we show that the indirect evidence component of *be supposed to* and *sollen* does not have an inferential flavour. While *must* and *müssen* are acceptable in the inferential context in (8), *be supposed to* and *sollen* are not. Meanwhile, like *must* and *müssen*, *be supposed to* and *sollen* are unacceptable when direct evidence for the prejacent proposition is available, as shown in (9).

(8) Context: The ball is either under cup A, cup B, or cup C. It's not under A, and it's not under B.
  a. The ball must be under cup C. / Die Kugel muss unter Becher C sein.
  b. #It's **supposed to** be under cup C. / #Sie **soll** unter Becher C sein.

(9) Context: You look out the window and see that it is raining.
  a. It is raining. / Es regnet.
  b. #It must be raining. / #Es muss regnen.
  c. #It's **supposed to** be raining. / #Es **soll** regnen.

We wish to also highlight two additional properties of *be supposed to* and *sollen* in connection with the literature on modal evidentials (e.g., Faller 2012; Matthewson et al. 2007; Schenner 2008). First, note that *be supposed to* and *sollen* can be embedded.[3] This is shown in (10), where *be supposed to* and *sollen* occur in the antecedent of a conditional. We note that the modals are interpreted within the antecedent, and do not take scope over the entire conditional.

[2] On Lauer's view, there are no truly performative uses of deontic modals – rather, these are actually bouletic modals tracking speaker preferences, uttered by a speaker who has deontic authority. There is a possibly interesting connection here to the proposal by Matthewson and Truckenbrodt (2017), which we discuss further in section 6.2.

[3] See Schenner (2008) for discussion of the embedding possibilities for *sollen* based on corpus data.

(10) Context: You and a friend are planning to go sightseeing in Edinburgh. Your friend asks if you should bring umbrellas. You don't know what the weather will be like, so you say:

a. If it's **supposed to** rain, we will bring umbrellas.
$=$ 'If it is reported that it will rain, we will bring umbrellas.'
$\neq$ 'It is reported that if it will rain, we will bring umbrellas.'

b. Wenn es regnen **soll**, bringen wir Schirme mit.
$=$ 'Wenn berichtet wird, dass es regnen wird, bringen wir Schirme mit.'
$\neq$ 'Es wird berichtet, dass wenn es regnet, wir Schirme mitbringen.'

Second, note that the reportative component projects out of negation. For instance in (11), the reportative component of *be supposed to* or *sollen* is not what is being denied. It appears then that the reportative component *be supposed to* and *sollen* is presuppositional, as has been claimed for evidential modals in other languages (e.g., Matthewson et al. 2007).

(11) Context: You and a friend are planning to go sightseeing in Edinburgh. Your friend asks if you should bring umbrellas. You say:

a. It's not **supposed to** rain.
$=$ 'It is reported that it won't rain.'
$\neq$ 'There is no reportative evidence that it will rain.'
$\neq$ 'The evidence that it will rain is not reportative.'

b. Es **soll** nicht regnen.
$=$ 'Es wird berichtet, dass es nicht regnen wird.'
$\neq$ 'Es gibt keine Berichte darüber, dass es regnen wird.'
$\neq$ 'Die Evidenz dafür, dass es regnen wird, ist nicht reportativ.'

In sum, the projection behaviour of *be supposed to* and *sollen* is similar to what has been described for other reportative evidential modals.

We now turn to which sources for reports can serve to license *be supposed to* and *sollen*. As illustrated in (10) and (11), speakers can use information they got from a specific definite entity, such as a weather report website. The reportative context in (1) showed that a speaker's utterance can also serve as a source for a report. Below we discuss some cases where identifying the source is more difficult.

The source of a report may be indefinite or unknown. As illustrated in (12), the precise identity, and in turn the reliability of the report, may be unknown.

(12) Context: A and B are newspaper reporters working on a story about a corrupt politician. A receives an anonymous phone call from an individual claiming that the politician accepted a bribe from a construction company. B asks what the phone call was about, and A replies:

a. The politician is **supposed to** have accepted a bribe from the construction company on August 15.

b. Der Politiker **soll** am 15. August Schmiergeld von der
the politician SOLL on 15 August bribe from the
Baufirma angenommen haben.
construction.company accepted have

Here, the identity of the anonymous caller is unknown to A, but nevertheless serves as a source for a report made by *be supposed to/sollen*. When asked later, A is able to pick out the time of the report: namely when the call happened. However, A is not able to pick out the source of the report as A's acquaintance relation to the source does not allow this.

In some cases, speakers can use *be supposed to* and *sollen* reportatively even when they are not able to pick the individual who is the source of the report or even the exact time the report was made. Consider the following context in (13).

(13) Context: A goes to dinner with a group of people. The conversation turns to ways to avoid sunburn. B says he has started to drink carrot juice.

B: Carrot juice is **supposed to** protect the skin from sunburn.

B: Möhrensaft **soll** vor Sonnenbrand schützen.
carrot.juice SOLL before sunburn protect

A: Oh, where did you hear that?

B: I don't remember.

In this context, speaker B can use *sollen* to indicate that he has reportative evidence for his statement, even though he cannot remember the exact source of the information.

In a context where the speaker is the source of the prejacent *p* and has complete control over *p*, this may be reported using *be supposed to/sollen*(*p*).[4] As shown in (14), a modified version of (6), the speaker may not have even said anything aloud to anyone.

(14) Context: The speaker spent New Year's at home by herself, but made a resolution to smoke less this year. On January 2, she is offered a cigarette.

a. I'm **supposed to** smoke less this year.

b. Ich **soll** dieses Jahr weniger rauchen.
I SOLL this year less smoke

We also note that *be supposed to/sollen*(*p*) can be licensed even if a report was not literally of *p*, but where *p* is entailed or conversationally follows from a report in context.

[4] In terms of a public commitment, which we will make reference to in our analysis in the next section, a commitment counts as public as soon as the speaker has formed a conscious thought about it.

(15) Context: A goes to dinner with a group of people who are discussing how to avoid sunburn. B says he has started drinking carrot juice. Then A comes home and reports what she learned.
  a. Carrot juice is **supposed to** help avoid sunburn.
  b. Möhrensaft **soll** vor Sonnenbrand schützen.
     carrot.juice SOLL against sunburn protect

4. Towards a unified analysis

Given the similarities we have observed between the deontic and reportative uses of *be supposed to* and *sollen*, we wish to provide a unified analysis for these modal expressions. We will make use of a standard Kratzerian framework (Kratzer, 1981, 1991, 2012), whereby modals quantify over possible worlds. We propose that both *be supposed to* and *sollen* are necessity modal expressions, which lexically specify a circumstantial modal base and a reportative informational ordering source. We discuss each of these ingredients in turn.

Given a circumstantial modal base, *be supposed to* and *sollen* quantify over worlds where salient facts in the evaluation world also hold (Kratzer, 2012; Portner, 2009). Crucially, one of the salient facts will be that a report of some kind has been made. This seems to be what we need for the reportative use, but for the deontic use it is possibly too strong. Specifically, what counts as a deontic report for *be supposed to* and *sollen*? It seems that someone need not have actually said anything at all. In (2), for instance, the parking prohibition may be indicated by a sign; in (3), it is likely the instruction booklet written by the creators of Monopoly that serves as the source of the rule. And even for true reportatives, the speaker may not be able to identify the individual or exact time of the relevant report, only that there was one. For these reasons, we leave fairly vague what counts as a relevant report in the circumstantial modal base, and state this "reportative" restriction on the circumstantial modal base as one where some agent α has some public commitment(s) from with the prejacent proposition *p* follows, as in (16):

(16) "Reportative" restriction on circumstantial modal base:
  $\exists\alpha$: *p* follows from α's public commitments

We assume that entities such as the city councillors responsible for parking laws or the creators of Monopoly count as relevant agents α for this purpose. Note that given cases like (15), it is too strong to say that α's public commitments entail *p*; in at least some cases, such as (15) above, *p* follows conversationally from α's public commitments. Nevertheless, in some cases entailment will turn out to follow, as in (17).

(17) Context: The weather report predicts rain every day next week.
  a. It's **supposed to** rain on Wednesday.
  b. Es **soll** am Mittwoch regnen.
     it SOLL on Wednesday rain

Note also that if it is already part of the circumstances that p follows from α's existing public commitments, this means that the temporal condition in (7) holds. That is, $\Box p$ holds throughout the reference time t, since α's commitment to p already holds at t.

As for the ordering source, we adapt the notion of a reportative informational conversational background developed by Kratzer (2012) for evidential modals. Our proposed ordering source is stated as in (18); although we maintain the terminology "reportative", this notion is here relativized to α's public commitments, and not literally a report.

(18) "Reportative" informational ordering source:
a function $g_{\alpha,t}$ such that for any w in the domain of $g_{\alpha,t}$, $g_{\alpha,t}(w)$ represents the propositional content of α's public commitments in w at a time t

Putting this all together, *be supposed to* and *sollen* take as a modal base a set of worlds where a set of relevant circumstances are true, and in particular where there is some α from whose public commitments p follows. These worlds are then ordered by the ordering source. Worlds where the content of α's public commitments are true are ranked higher than worlds where this content is not true. Both *be supposed to* and *sollen* then universally quantify over the best worlds of the modal base as ranked by the ordering source. We assume that the lexical specification of the modal base and ordering source is treated as a presupposition on available conversational backgrounds in the context (cf. Matthewson et al. 2007). This is summarized in (19).

(19) $[\![\textit{be supposed to/sollen}]\!]^{c,w,t}$
$= \lambda P \lambda x[\forall m \in t[\forall w' \in \max_{g_m(w)}(\bigcap f_m(w)) : P(x)(w') = 1]]$
defined only if the context c provides a circumstantial modal base f_m and reportative informational ordering source $g_{\alpha,m}$

One last comment is in order regarding our semantics in (19). We follow Hinterwimmer (2013) in treating the subject as an external argument of *sollen*, and by extension *be supposed to*. In other words, we treat *be supposed to* and *sollen* as control predicates rather than raising predicates.[5] There is some debate over the status of (non-epistemic) modals as raising or control predicates (see von Fintel and Iatridou 2009 for discussion). We have no new syntactic tests to bear on this issue, and applying the standard tests yields unclear results. Since the reportative reading of *be supposed to* and *sollen* is plausibly epistemic, while the deontic reading is root, and our analysis merges the two, it is not clear what behaviour we would predict. As we will see in the next section, we will need the semantics to make reference to the grammatical subject when we compare *sollen* with *wollen*, another German modal with a reportative flavour. We turn to this now.

5. Comparing German *sollen* and *wollen*

It is quite well-known that *sollen* is dispreferred when the issuer of the report is identical with its grammatical subject (Hinterwimmer, 2013; Kratzer, 1981; Schenner, 2008). In such a case,

[5] This means that technically we don't have a prejacent *proposition*, but we will ignore this issue in this paper.

the quotative modal *wollen* 'want' is typically used in order to convey that its subject is the source of a report of the prejacent proposition. This contrast is shown in (20)-(22).

(20) a. Anna **soll** in Oslo sein.
Anna SOLL in Oslo be
'Anna is said to be in Oslo.' (someone other than Anna is the source)
b. Anna **will** in Oslo sein.
Anna want in Oslo be
'Anna claims to be in Oslo.' (Anna herself is the source)
(adapted from Schenner 2008)

(21) Context: Julia has overheard Max saying that he climbed Mount Everest.
Max **will** den Mount Everest bestiegen haben.
Max want the.ACC Mount Everest climbed have
'Max claims to have climbed Mount Everest.'
(adapted from Gärtner 2012)

(22) Context: You're at a party, and at 8pm someone asks when Maria will arrive. Earlier today, she told you she would arrive at 9pm.
a. Maria is **supposed to** be here at 9pm.
b. Maria {**will/#soll**} um 9 hier sein.
Maria want/SOLL at 9 here be

It would seem that our analysis as it stands now cannot account for these facts. Our analysis simply requires that the fact that some agent α has a public commitment to p be part of the circumstantial ordering source associated with *sollen* (and *be supposed to*). It is thus mysterious why *sollen* is infelicitous in (22).

Our proposal to account for this data is the following. We maintain our semantics for *sollen* and *be supposed to* as in (19). However, we argue that *sollen* is infelicitous in (22) due to pragmatic competition with *wollen*. The main idea is that the quotative use of *wollen* has the same semantics as *sollen*, but with the extra presupposition that the source of the report is the same as the subject of the sentence (cf. Gärtner 2012; Schenner 2008). In such a setup, *sollen* and *wollen* compete via Maximize Presupposition (e.g., Percus 2006; Schlenker 2012; cf. Heim 1991), defined in (23).

(23) *Maximize Presupposition:*
If a sentence S is a presuppositional alternative of a sentence S', and the context C is such that
a. the presuppositions of S and S' are satisfied within C
b. S and S' have the same assertive component relative to C
c. S carries a stronger presupposition than S'
then S should be preferred to S'. (adapted from Schlenker 2012)

Under our analysis, *sollen* and *wollen* have the same assertive component, but *wollen* carries a stronger presupposition. Namely, *wollen* is associated with the presupposition that its subject has the public commitment to the prejacent, whereas *sollen* carries no presupposition about the identity of the agent who has a public commitment. Therefore, by (23) sentences containing *sollen* and *wollen* are presuppositional alternatives for a Maximize Presupposition competition, and *wollen* must be used whenever its presuppositions are supported in the context. In such contexts, the use of *sollen* is blocked, leading to the contrast in (22).

An analysis along these lines makes the prediction that in cases where it is not known by the speaker whether the subject carries the relevant public commitment, *sollen* can be used. This prediction is borne out, as illustrated in (24). In the context provided, the source of the public commitment could very well be the subject, but could also be someone else. The judgment here is that A's utterance with *sollen* is neutral with respect to whether A thinks that Chris or someone else is the source of the report, whereas the response in A′ strongly implies that A′ believes that Ben's knowledge comes directly from Chris as the source of the report.[6]

(24) Context: Alex and Ben are planning a party. Their flaky friend Chris only sometimes RSVPs to parties, and one might only hear about Chris's attendance through rumours.
A: **Soll** Chris zur Party kommen?
SOLL Chris to.the party come
'Is Chris coming to the party?'
(A doesn't know whether B heard from Chris or someone else)
A′: **Will** Chris zur Party kommen?
want Chris to.the party come
'Is Chris coming to the party?'
(only: A′ believes Chris is the source)

In sum, we maintain an identical analysis for *sollen* and *be supposed to*. The apparent restriction of *sollen* to cases where the subject is not identical to the source of the report is due to a Maximize Presupposition competition with *wollen*. Since English *be supposed to* does not have a competitor akin to *wollen*, we observe differences in the distribution of *be supposed to* and *sollen* despite their identical semantics.

6. Comparison to other analyses

We have claimed that the modal expressions *be supposed to* and *sollen* both have uses that place a restriction that there exists an agent α who has a public commitment towards the prejacent. We have also argued that apparently deontic uses of these modal expressions should be assimilated to reportative uses as well. In such a case, a pre-existing law or rule can count as a report to license *be supposed to* and *sollen*. In this section, we would like to defend our analysis by comparing it to two recent proposals for *sollen*, both of which deny that *sollen* is reportative per se: Hinterwimmer (2013), which invokes intentional acts rather than reports, and Matthewson and Truckenbrodt (2017), who argue for an external bouletic ordering source for *sollen*.

[6]Note that this example involves so-called "interrogative flip," whereby A expects B to base their answer on reportative evidence. This use of reportatives is quite common cross-linguistically (e.g., Davis et al. 2007; Faller 2002; Garrett 2001; Matthewson et al. 2007).

6.1. Hinterwimmer (2013)

As we have already seen, it seems too strong to say that it is strictly antecedent reports that license *be supposed to* and *sollen*. We need to at least allow pre-existing laws and rules under the umbrella of licensors. Hinterwimmer (2013) also argues that reports are strictly speaking too narrow a category to account for the uses of German *sollen*. He argues that *sollen* requires an antecedent **intentional act**, which is not necessarily a speech act. He takes cases like (25) as evidence for this claim.

(25) Context: Peter is singing *Yesterday* to his baby daughter.
A: Why is he doing that?
B: Das **soll** das Baby beruhigen.
it SOLL the baby calm.down
'It's supposed to calm the baby down.' (Hinterwimmer, 2013)

The idea is that in this context, there is no prior report (or rule or law for that matter) that Peter should sing in order to calm the baby down; rather, Peter is just trying anything he can think of to calm the baby down. In such a context, what licenses B's use of *sollen* is thus not a report of any kind, but rather the singing itself. That is, the singing itself serves as an antecedent intentional act for B's use of *sollen* in (25) – Peter's intentional act of singing is enough to license *sollen*. Thus, Hinterwimmer claims, *sollen* requires any sort of antecedent intentional act, even if it is not strictly speaking a speech act.

We believe Hinterwimmer's analysis is not on the right track for at least two reasons. First, native speakers we have consulted seem to agree that there is a prior report in (25) that is accommodated in contexts where it is not explicitly mentioned. This is what is predicted by our account. Under our analysis, that an agent α has p as a public commitment is part of the content of the circumstantial modal base, which under our analysis is a presupposition associated with *be supposed to* and *sollen*. This means that an antecedent report (or rule/law) must be retrievable to the interlocutors. In cases where this fails, we predict that a report must be accommodated by the hearer for the use of *be supposed to* or *sollen* to be felicitous. Second, even when the context is such that no prior report can be accommodated because the interlocutors have never met each other or Peter, there is a world knowledge rule 'singing calms the baby down' that could in principle serve as the 'source of the report' and thus as a possible confound. Consider (26) which avoids this confound.

(26) Context: Peter is stirring ketchup into his coffee.
A: Why is he doing that?
B: Das **soll** gut schmecken. = 'It's supposed to taste good.'
A: Oh. Where did you hear that?
B: I don't remember, I think I read it in some magazine a while ago.
B′: #He's doing it right now.

We assume that there is no world knowledge rule stating that adding ketchup to coffee will make it taste better. A's continuation of B's use of *sollen* is very natural here. We take this to show that while A interprets B's utterance as referring to a prior report, but is unable to accommodate the existence of a source for such a report. It is important to note that the response of B′ that 'He's doing it right now' is not a felicitous continuation of the exchange. This is unexpected if we assume the action of stirring ketchup to be an antecedent intentional act in the sense of Hinterwimmer. *Sollen* should be able to pick up Peter's intentional act.

6.2. Matthewson and Truckenbrodt (2017)

We next turn to a recent proposal by Matthewson and Truckenbrodt (2017), who distinguish between root and evidential *sollen* and argue that root *sollen* is 'externally bouletic', i.e., the modal flavour of root *sollen* is always bouletic, and the subject of the clause cannot be the holder of the desire. What they mean by this is illustrated in (27), their own example.

(27) A: Why have you put on loud and unpleasant music in the basement?
B: It is **supposed to** chase away the mice.
Das **soll** die Mäuse verjagen.
that SOLL the mice chase.away

The context for this example is similar to, though slightly different[7] from, the earlier example (25) from Hinterwimmer about calming down the baby. Similar to (25), we disagree with the judgment regarding B's use of *be supposed to*/*sollen* in (27). In particular, we find the continuation in (27′) to be the most natural follow-up to B's utterance in (27). Like in (26), A's response here seems to be a variety of a "Hey wait a minute" response (see von Fintel 2004) that challenges the presupposition of B's utterance, namely the presupposition that there is some agent from whose public commitments the prejacent follows.

(27′) A: Where did you hear that?
Wo hast du das gehört?

Additionally, we believe that the restriction that the subject of the clause not be equal to the holder of a desire does not quite capture all the relevant facts. This condition is both too weak and too strong. First, it is too weak because it predicts that *sollen* should be licensed whenever there is an inanimate or expletive subject, so long as there is some holder of a desire in the context. Although Matthewson and Truckenbrodt's (27) appears to show this prediction is upheld, we have already indicated that our judgments in this case do not match theirs. In (28) with an expletive subject, we see that *sollen* cannot take on the bouletic reading; only a reportative reading is available here.

(28) Context: A and B hear that Peter, an author, has started writing another story.
A: In seiner Geschichte soll es um Pferde gehen.
in his story SOLL it about horses go
'His story is supposed to be about horses.' (reportative only)
≠ 'Peter (or someone) wants his story to be about horses.'

[7] It is different in that the speaker is the bouletic source in (27).

Matthewson and Truckenbrodt predict that an externally bouletic interpretation should be available, either such that the speaker desires Peter to write his next story about horses, or that Peter has that desire himself, since Peter is not the subject of (28). Despite the availability of two plausible sources for the bouletic desire, such an interpretation of (28) is not available. The only available interpretation is a reportative one: A has heard a report that Peter's new story will be about horses and is sharing this information with B by uttering (28).

Second, the restriction that the subject be distinct from the holder of a desire also seems to be too strong in certain cases. We have already seen in (24) that in ignorance contexts, the use of *sollen* is compatible with the subject being the holder of a desire. That is, by uttering *Soll Chris zur Party kommen?* ('Is Chris coming to the party?'), the speaker is not committed to Chris not being the source of a bouletic attitude towards coming to the party. We have also seen in (6) and (14) more cases where the speaker is source of the report.[8]

Matthewson and Truckenbrodt could perhaps not consider these as counterexamples if they treat them as purely reportative uses of *sollen*, which they treat as distinct from their root bouletic use. Under a Kratzerian framework, this amounts to leaving underspecified the types of modal bases and ordering sources that *sollen* can take, just like other modals that can take on several modal flavours. However, given the similarities we have observed between the deontic and reportative uses of *be supposed to* and *sollen*, we believe our unified analysis provides an explanation for the lexicalization of the reportative and non-performative deontic readings together in the same modal expressions: these two readings are in essence one and the same.

Even allowing that in an example such as (1), Professor Plum's presence is bouletically desired by the university rather than mandated, it is not clear how this extends to, e.g., the city parking laws as discussed in example (2), repeated here as (29).

(29) Context: Your friend has just parked in front of a fire hydrant. You say:
a. You're not **supposed to** park there.
b. Du **sollst** hier nicht parken.
you SOLL here not park

Here it seems like a stretch to argue that the city is an agent with desires, so assuming a bouletic flavour seems impossible. On Matthewson and Truckenbrodt's account, (29) would have a purely reportative reading with no deontic flavour. On our account, both are present.

There are some cases where Matthewson and Truckenbrodt's analysis makes different predictions than ours. First, they observe a case where the judgments come apart for *be supposed to* and *sollen* in a deontic context, namely (30). Matthewson and Truckenbrodt take this as evidence that *sollen* can not take on a deontic flavour, although *be supposed to* can.

[8] Note that *wollen* is also acceptable in these cases.

(30) Context: Nobody said anything to A about locking the building. However, there is a rule that you lock the building when you are the last to leave.
a. A to B: I'm **supposed to** lock the door.
b. A to B: #Ich **soll** noch das Gebäude abschließen.
I SOLL still the building lock
(Matthewson and Truckenbrodt, 2017)

We agree with the judgment here and have no explanation for this. We would, however, like to point out two additional factors that may influence the judgments here. The German particle *noch* 'still' seems to play a crucial role in making (30) unacceptable. Without *noch*, the utterance with *sollen* is fine. Additionally, we also observe that adding *auch* 'also' improves acceptability.

(30′) Ich **soll** (auch noch) das Gebäude abschließen.
I SOLL also still the bulding lock
'I'm also supposed to still lock the building.'

While Matthewson and Truckenbrodt's account does not predict the acceptability of (30′), ours does not predict why (30) is unacceptable. Another possible factor causing the inacceptability of (30) is competition with *müssen*. A version of this sentence with *müssen* as in (30″) can convey both deontic necessity and inferential reasoning and thus captures both the fact that A is following a rule, and that A had to deduce that the rule applies to him.

(30″) Ich muss noch das Gebäude abschließen.
I must still the building lock
'I still have to lock the building.'

A case that Matthewson and Truckenbrodt can deal with easily, but which causes problems for our account, are examples like (31). In this bouletic context, *be supposed to* is unacceptable, as we predict. However, *sollen* is (marginally) acceptable here. (Note that our English translation for (31b) is not intended as an analysis of the German sentence; we simply offer this as a paraphrase that is colloquially appropriate in the given context.)

(31) Context: I haven't yet looked at what the cafeteria is offering for lunch, but I really hope they are serving pasta.
a. #They are **supposed to** have pasta today!
b. Sie **sollen** heute Nudeln haben!
they SOLL today noodles have
≈ 'I hope they have pasta today!'

This stands in contrast to (32), where both *be supposed to* and *sollen* are unacceptable. Here, there is a report in the context that the prejacent of *be supposed to* and *sollen* is in fact false.

(32) Context: I just checked the cafeteria's lunch offers for the day and saw that they are not offering pasta, my first choice.
a. #They are **supposed to** have pasta today!
b. #Sie **sollen** aber heute Nudeln haben!
they SOLL but today noodles have

It seems to us that the speaker of the German sentence in (31) appears to be childish or irrational. We take this to be an effect caused by using an expression expressing deontic modality where bouletic modality would be appropriate. It is our intuition that the speaker is attempting to make the desire more 'objectively necessary' by using an expression that is only compatible with deontic modality – the speaker is exploiting the fact that only deontic modality, but not bouletic modality, is available for *sollen*.

We would like to make one final comment here about the relation between bouletic and deontic modality. Lauer (2015) suggests that performative deontic modals actually convey speaker preferences. When the speaker is a deontic authority, a statement about speaker preferences can take on the force of placing an obligation on the hearer via pragmatics. Thus, there may be an important connection between deontic and bouletic modality that could go some way towards unifying our account with that of Matthewson and Truckenbrodt. However, note that Lauer's idea is about *performative* uses of deontic modals, and we have argued in this paper that the deontic uses of *be supposed to* and *sollen* are crucially anti-performative.

7. Conclusion

We have proposed a unified analysis for the deontic and reportative readings of *be supposed to* and *sollen*: both readings are derived from a circumstantial modal base and a reportative informational ordering source. This accounts for the fact that even the deontic use of these modals still have a reportative flavour in that they cannot be used performatively to issue an obligation on the hearer. Despite the open questions that remain, we hope to have made a contribution to the enterprise of making more precise the properties of the modal flavours associated with *be supposed to* and *sollen*.

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Nominalized clauses and reference to propositional content[1]

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Abstract. We investigate the semantics of Korean embedded clauses that bear the nominalizer *kes* and declarative marker *ta*. Such clauses can be embedded by *mit* 'believe.' While such clauses are not factive (Shim and Ihsane 2015), we present elicitation data that shows that nominalized (*ta-kes*) clauses are felicitously embedded by *mit* only if their conveyed content was previously asserted in the context; no such restriction arises for non-nominalized clauses. Our analysis of such nominalized embedded clauses argues that they do not denote a proposition — a set of possible worlds — but rather a definite description of a discourse event — an assertion event — that carries propositional content. The use of *ta-kes* embedded clauses allows Korean verbs like *mit* to acquire felicity conditions similar to those proposed for response-stance verbs (e.g. *agree*, *deny*) (Cattell 1978, Anand and Hacquard 2014).

Keywords: attitude verbs, nominalized clauses, reported discourses, Korean

1. Introduction

Clause-embedding verbs are often divided into different classes based on certain aspects of the embedded clause's interpretation. Classification schemes include those by Kiparsky and Kiparsky (1970), Hooper and Thompson (1973), Cattell (1978), Hegarty (1992), and Anand and Hacquard (2009, 2014). The classification from Cattell (1978) is given below.

(1) a. *Volunteered-stance / non-factive:* Embedded clause introduces new idea
Alice {believed/said/assumed/thought/claimed/supposed} that Ron called.
b. *Non-stance / factive:* Embedded clause refers to a fact
Alice {remembered/regretted/knows/forgot/realized} that Ron called.
c. *Response-stance:* Embedded clause refers to a familiar idea
Alice {agreed/admitted/confirmed/denied/accepted} that Ron called.

Cross-linguistic investigations of clausal embedding have observed that complements to verbs classified as *non-stance* (1b) or *response-stance* (1c) often exhibit morphosyntactic properties suggestive of nominal structure. The exact nature of these properties varies across languages. In some languages, the relevant embedded clauses occupy syntactic positions otherwise reserved for nominal expressions, e.g. Dutch: (Barbiers, 2000; Haegeman and Ürögdi, 2010). In many other languages, embedded clauses are associated with (or perhaps headed by) proforms or demonstratives: such languages include English (Kiparsky and Kiparsky, 1970), German (Sudhoff, 2003; Zimmermann, 2016), Hebrew (Kastner, 2015), Greek (Roussou, 1991; Kallulli, 2006), Albanian (Kallulli, 2006), Bulgarian (Krapova, 2010), and Hungarian (Abrusán, 2011).

[1]New judgments (those not otherwise attributed) for Korean reported here are from Chung-hye Han, whose input was invaluable to this project. This project was funded by SSHRC Insight Grant (#435-2015-0454) to Keir Moulton and Junko Shimoyama.

Previous research largely agrees that apparent nominal morphosyntactic properties of embedded clauses do not strictly correlate with factivity.[2] However, there is significant variation in the characterization of these complements. Among the terms used to describe them are "referential propositions" (de Cuba and Ürögdi, 2009; Haegeman and Ürögdi, 2010), "familiar" (de Cuba, 2007), "presuppositional" (Kastner, 2015), and "given" (Zimmermann, 2016). This primarily syntactic literature does not discuss in detail the contexts that license such clauses, nor does it clarify what type of semantic object these clauses denote. For example, if they denote propositions as in Haegeman and Ürögdi (2010), what exactly does it mean for a proposition — a set of possible worlds — to 'refer' (Bhatt, 2010; Kastner, 2015)?[3]

This paper begins to examine these questions by asking what it might mean for a clause to 'refer.' Our focus is Korean sentences like (2). The embedded clause in (2) bears the nominalizer *kes* in addition to the declarative mood marker *ta* (Kim, 2009; Yoon, 2013; Shim and Ihsane, 2015). The nominalized clause in (2) is embedded not by a factive or response-stance verb, but rather by *mit* 'believe,' a volunteered-stance verb.

(2) Kibo-nun [Dana-ka i chayk-ul ilk-ess-**ta**-nun **kes**-ul] mit-ess-ta.
K.-TOP D.-NOM this book-ACC read-PST-DEC-ADN *kes*-ACC believe-PST-DEC
'Kibo believed (the claim) that Dana read this book.' (Shim and Ihsane, 2015: (4b))

After §2 places sentences like (2) in the context of prior work on other types of Korean embedded clauses (Kim, 2009; Yoon, 2013; Shim and Ihsane, 2015), §3 presents new data about the contexts that license sentences like (2): (2) is only felicitous if the content conveyed by the embedded clause was previously asserted in the context. In §4, we propose that embedded clauses like (2) do not denote propositions but instead definite descriptions of assertion events that carry propositional content. When *mit* 'believe' embeds a *kes*-clause (2), its interpretation resembles that of sentences with response-stance verbs (2c) under Anand and Hacquard's (2014) proposal that such verbs report discourse moves.

2. The structure and basic interpretation of *kes*-clauses

Kim (2009) discusses three types of Korean *kes*-constructions: internally-headed relative clause (IHRC) (3a), perception, (3b), and factive (3c) constructions.

(3) a. John-un [totwuk-i tomangka-n-un **kes**-ul] cap-ess-ta.
J.-TOP thief-NOM run.away-IMPF-ADN *kes*-ACC catch-PST-DEC
'John caught the thief that was running away.'
(*Internally-headed relative clause (IHRC) construction*, Kim, 2009: (1))

b. John-un [totwuk-i tomangka-n-un **kes**-ul] po-ess-ta.
J.-TOP thief-NOM run.away-IMPF-ADN *kes*-ACC see-PST-DEC
'John saw (the event) of the thief running away.'
(*Perception construction*, Kim, 2009: (2))

[2]For arguments that factivity is the crucial notion in Albanian and Greek, see Kallulli (2006, 2010).

[3]Treatments of reference to propositions that can be found in Asher (1993) and Chierchia (1984) are not addressed in the literature on nominalized clauses cited above.

c. John-un [totwuk-i tomangka-n-un **kes**-ul] al-ess-ta.
J.-TOP thief-NOM run.away-IMPF-ADN *kes*-ACC know-PST-DEC
'John knew (the fact) that the thief was running away.'
(*Factive construction*, Kim, 2009: (3))

In each example above, the *kes*-clause is an invariant string but its interpretation appears to depend on the nature of the verb that embeds it. Kim (2009) gives a compositional and largely unified account of *kes*-clauses where *kes* denotes individuals of different sorts: ordinary entities (3a), events (3b), and facts (3c). This treatment of *kes* is superficially supported by the translation of such Korean sentences into English using the nouns *event* (3b) and *fact* (3c).[4] However, Kim (2009) does not discuss *kes*-clauses of the shape in (4), which are our focus:

(4) Kibo-nun [Dana-ka i chayk-ul ilk-ess-**ta**-nun **kes**-ul] mit-ess-ta.
K.-TOP D.-NOM this book-ACC read-PST-DEC-ADN *kes*-ACC believe-PST-DEC
'Kibo believed (the claim) that Dana read this book.' (Shim and Ihsane, 2015: (4b))

Unlike the *kes*-clauses in (3a)–(3c), the embedded clause in (4) contains the declarative mood marker *ta* in addition to nominalizer *kes*. The morpheme *ta* also occurs on verbs in main clauses that express assertions, as in *mit-ess-ta* 'believed' in (4). It is in complementary distribution with elements like the question and imperative markers. The embedded *kes*-clause in (4) is translated into English with the noun *claim*, rather than *event* (cf. (3b)) or *fact* (cf. (3c)).

The main previous discussion of sentences like (4) comes from Shim and Ihsane (2015), who demonstrate that Korean verbs such as *mit* 'believe' can embed *kes*-clauses that contain *ta* (4) as well as *kes*-clauses of the shape in (5). The *kes*-clause in (5) has the same morphosyntactic form as the *kes*-clauses investigated by Kim (2009): (5) lacks the declarative marker *ta*.

(5) Kibo-nun [Dana-ka i chayk-ul ilk-ess-nun **kes**-ul] mit-ess-ta.
K.-TOP D.-NOM this book-ACC read-PST-ADN *kes*-ACC believe-PST-DEC
'Kibo believed (the fact) that Dana read this book.' (Shim and Ihsane, 2015: (4c))

In addition to both types of *kes*-clauses, *mit* also embeds clauses of the shape in (6), which bear declarative marker *ta* but lack *kes*; the clause instead bears complementizer *ko*, which is not nominal (does not accept case).

[4] As discussed by Chae (2007) and references therein, the Korean morpheme *kes* has been variously characterized as a nominalizer, pronoun, and complementizer. For terminological consistency, we refer to *kes* as a nominalizer below. Morphological evidence that for the nominal character of *kes*-clauses comes from the presence of *un* (a relativizer or adnominalizer) and case marking (e.g. accusative marker *ul*). It is not possible for a *kes*-clause to occur without an embedding verb (i).

(i) *Lee-ka hoyngryengha-ss-ta-nun **kes**-ul
Lee-NOM embezzle-PST-DEC-ADN *kes*-ACC
(*Intended:* 'The fact, claim that Lee embezzled.') (Yoon, 2013: (12))

(6) Kibo-nun [Dana-ka i chayk-ul ilk-ess-**ta-ko**] mit-ess-ta.
K.-TOP D.-NOM this book-ACC read-PST-DEC-*ko* believe-PST-DEC
'Kibo believed that Dana read this book.' (Shim and Ihsane, 2015: (4a))

Shim and Ihsane show that the constructions in (4) and (6) are both non-factive. The continuation '...but Dana didn't read it' was felicitous after embedded clauses containing both *ta* and *kes* (7a) and embedded clause containing both *ta* and *ko* (7b).

(7) a. Kibo-nun [Dana-ka i chayk-ul ilk-ess-**ta**-nun **kes**-ul] mit-ess-ta,
K.-TOP D.-NOM this book-ACC read-PST-DEC-ADN *kes*-ACC believe-PST-DEC
kulente sasil-un Dana-nun i chayk-ul ilk-ci anh-ass-ta.
but fact-TOP D.-TOP this book-ACC read-NEG-PST-DEC
'Kibo believed (the claim) that Dana read this book, but D. didn't read it.'
(Shim and Ihsane, 2015: (5b))

b. Kibo-nun [Dana-ka i chayk-ul ilk-ess-**ta-ko**] mit-ess-ta,
K.-TOP D.-NOM this book-ACC read-PST-DEC-*ko* believe-PST-DEC
kulente sasil-un Dana-nun i chayk-ul ilk-ci anh-ass-ta.
but fact-TOP D.-TOP this book-ACC read-NEG-PST-DEC
'Kibo believed that Dana read this book, but D. didn't read it.'
(Shim and Ihsane, 2015: (5a))

The absence of factivity in (7a) and (7b) is not surprising: as a canonical volunteered-stance verb, *mit* 'believe' is not among those verbs we expect to have factive interpretations.[5] However, Shim and Ihsane observe that when *mit* embeds clauses that contain *kes* but lack *ta*, a factive interpretation arises:

(8) #Kibo-nun [Dana-ka i chayk-ul ilk-ess-**nun** **kes**-ul] mit-ess-ta,
K.-TOP D.-NOM this book-ACC read-PST-ADN *kes*-ACC believe-PST-DEC
kulente sasil-un Dana-nun i chayk-ul ilk-ci anh-ass-ta.
but fact-TOP D.-TOP this book-ACC read-NEG-PST-DEC
#'Kibo believed (the fact) that Dana read this book, but D. didn't read it.'
(Shim and Ihsane, 2015: (5c))

We elicited additional data that support the restriction of factivity for *mit* sentences to those whose embedded clauses contain only *kes*. For a false embedded proposition (*that Sydney is the capital of Australia*), it is infelicitous for *mit* to embed the clause marked with *kes* alone (9a). By contrast, *mit* can felicitously embed clauses that contain both *kes* and the declarative marker (realized here as *la*) (9b) as well as clauses that contain both *ko* and the declarative marker (9c). (The declarative marker is realized as *la* in (9) rather than *ta*.)

[5] As Shim & Ihsane (2015) point out, sentences with *yukamsuleweha* 'regret' as the embedding verb have a factive interpretation regardless of the morphosyntax of the embedded clause. This suggests that while choice of embedded morphology may drive factivity with verbs like *mit* 'believe,' other verbs may lexically impose factivity on their complements, as in Kiparsky & Kiparsky (1970) and subsequent work.

(9) *Context:* Kibo's stupid friend Dana told him that Sydney is the capital of Australia. Kibo missed the day of class where the children learned that Sydney is not the capital of Australia.

a. # Kulayse acikto Kibo-nun [Sydney-ka Australia-uy swuto-i-n **kes**-ul]
so still K.-TOP S.-NOM A.-GEN capital-COP-ADN *kes*-ACC
mit-e.
believe-DEC
#'Kibo still believes (the fact) that Sydney is the capital of Australia.'

b. Kulayse acikto Kibo-nun [Sydney-ka Australia-uy swuto-**la**-nun **kes**-ul]
so still K.-TOP S.-NOM A.-GEN capital-DEC-ADN *kes*-ACC
mit-e.
believe-DEC
'Kibo still believes (the claim) that Sydney is the capital of Australia.'

c. Kulayse acikto Kibo-nun [Sydney-ka Australia-uy swuto-**la**-**ko**] mit-e.
so still K.-TOP S.-NOM A.-GEN capital-DEC-*ko* believe-DEC
'Kibo still believes that Sydney is the capital of Australia.'

Following Shim and Ihsane (2015), we conclude that the morphosyntactic shape of clauses embedded by *mit* 'believe' correlates with the factivity of the sentence as a whole: factive interpretations arise if the embedded clause contains only *kes*, but not if the embedded clause contains both *ta* and *kes* or both *ta* and *ko*.

3. Licensing *ta-kes*-marked clauses

While we agree with Shim and Ihsane (2015) that clauses with *ta* and *kes* and those with *ta* and *ko* are both non-factive, Shim and Ihsane (2015) — nor any other prior work on Korean embedded clauses, to our knowledge — do not discuss differences in the distribution or interpretation of these two types of embedded clauses. We turn to this now.

3.1. ϕ-*ta-kes*: ϕ previously asserted in local discourse

As previously discussed, the Korean verb *mit* 'believe' can embed clauses marked with declarative *ta* and nominalizer *kes* (abbreviated ϕ-*ta-kes*) or clauses marked with *ta* and complementizer *ko* (abbreviated ϕ-*ta-ko*). In the following discourse, both utterance B1 (ϕ-*ta-ko*) and utterance B2 (ϕ-*ta-kes*) were judged felicitous.

(10) **A:** Na-nun swukecey-lul ta ha-yess-e. Pakk-ey naka nola-to toy?
I-TOP homwork-ACC all do-PST-DEC outside-at go play-also can
'I finished my homework. Can I go outside and play?'

B: An toy.
not can
'No.'

A: Na-lul an mit-e?
I-ACC not believe-INT
'Don't you believe me?'

B1: Um. Na-nun [ney-ka swukecey-lul ta ha-yess-**ta-ko**] mit-e.
Yes. I-TOP you-NOM homework-ACC all do-PST-DEC-*ko* believe-DEC
Haciman cikum-un cenyek siksa sikan-i-ya.
but now-TOP evening meal time-COP-DEC
'Yes, I believe that you finished your homework. But it's dinner time.'

B2: Um. Na-nun [ney-ka swukecey-lul ta ha-yess-**ta**-nun **kes**-ul]
Yes. I-TOP you-NOM homework-ACC all do-PST-DEC-ADN *kes*-ACC
mit-e. Haciman cikum-un cenyek siksa sikan-i-ya.
believe-DEC but now-TOP evening meal time-COP-DEC
'Yes, I believe (the claim) that you finished your homework. But it's dinner time.'

In the following discourse, by contrast, only utterance B1 (ϕ*-ta-ko*) was accepted. The consultant rejected utterance B2, where *mit* embeds ϕ*-ta-kes*.

(11) **A:** Cyoni-nun pakk-ey naka nola-to toy?
J.-TOP outside-at go play-also can
'Can Johnny go outside and play?'

B1: Um. Na-nun [kay-ka swukecey-lul ta ha-yess-**ta-ko**] mit-e.
Yes. I-TOP he-NOM homework-ACC all do-PST-DEC-*ko* believe-DEC
'Yes, I believe that he finished his homework.'

B2:#Um. Na-nun [kay-ka swukecey-lul ta ha-yess-**ta**-nun **kes**-ul] mit-e.
Yes. I-TOP he-NOM hmwrk-ACC all do-PST-DEC-ADN *kes*-ACC believe-DEC
#'Yes, I believe (the claim) that he finished his homework.'

The key difference between the discourses in (10) and (11) is that only (10) contains a previous assertion that carries content comparable — if not string identical — to the ϕ later uttered by B: A asserts *I finished my homework*. In such discourses, both ϕ*-ta-kes* and ϕ*-ta-ko* were licit in utterances by B. When such a previous assertion is missing as in (11), only ϕ*-ta-ko* is licit.

It is not the case that ϕ*-ta-kes* is only licensed where ϕ corresponds to a direct quotation. The ϕ uttered by B in (10) is not string identical to the string previously uttered by A: whereas A's utterance contains a first person pronoun, B's utterance contains a second person pronoun. This point is made even more dramatically in the discourse in (12). Here, A's utterance of *I ate peas* only entails the proposition corresponding to the ϕ uttered by B. In addition to ϕ*-ta-ko* (B1), ϕ*-ta-kes* (B2) was also judged felicitous:

(12) *Context:* B has a rule that A must eat vegetables before having cake.
A: I ate peas! Can I have cake now?

B: No, you can't. **A:** But why? Don't you believe me?

B1: Na-nun [ney-ka yachae-lul mek-ess-**ta-ko**] mit-e...
I-TOP you-NOM vegetable-ACC eat-PST-DEC-*ko* believe-DEC
'I believe that you ate vegetables (...but the cake's not ready).'

B2: Na-nun [ney-ka yachae-lul mek-ess-**ta**-nun **kes**-ul] mit-e...
I-TOP you-NOM vegetable-ACC eat-PST-DEC-ADN *kes*-ACC believe-DEC
'I believe that you ate vegetables (...but the cake's not ready).'

However, while ϕ need not be string identical to a previous assertion, the propositional content associated with ϕ must be consistent with the content associated with the prior assertion. The consistency requirement was met in the entailment discourse in (12). However, it is not met in the discourse in (13), in which ϕ occurs in the scope of negation in A's previous assertion. As shown, A is not allowed to go on to use *ϕ-ta-kes* in a subsequent assertion. (Although not shown here, *ϕ-ta-ko* would have been licit.)

(13) **A:** Kibo has certainly heard in his geography class that Toronto is not the capital of Canada...

A: ...#Kulayto Kibo-nun [Toronto-ka Canada-uy swuto-**la**-nun **kes**-ul]
even.so K.-TOP T.-NOM C.-GEN capital-DEC-ADN *kes*-ACC
mit-e.
believe-DEC
'Even so, Kibo still believes that Toronto is the capital of Canada.'
C.H. Han's Comment: "This sounds really odd to me, if Kibo has never heard anybody tell him that 'Toronto is the capital of Canada'."

The prior act of *assertion* of ϕ — or material consistent with ϕ — is necessary for the felicity of *ϕ-ta-kes* under *mit* 'believe.' In the following discourse, we find that A's polar question (*Has Johnny finished his homework*) is not sufficient to license B's utterance of *ϕ-ta-kes* in B2, despite ϕ being string identical to the proposition on which A's polar question was formed. The infelicity of *ϕ-ta-kes* in B2 contrasts with the felicity of *ϕ-ta-ko* in utterance B1.

(14) **A:** Johnny-nun swukcey-lul ta ha-yess-ni?
J.-TOP homework-ACC all do-PST-Q
'Has Johnny finished his homework?'

B1: Na-nun [Johnny-ka swukcey-lul ta ha-yess-**ta-ko**] mit-nun-ta.
I-TOP J.-NOM homework-ACC all do-PST-DEC-*ko* believe-DEC
'I believe that Johnny finished his homework.'

B2: #Na-nun [Johnny-ka swukcey-lul ta ha-yess-**ta**-nun **kes**-ul]
I-TOP J.-NOM homework-ACC all do-PST-DEC-ADN *kes*-ACC
mit-e.
believe-DEC
#'I believe (the claim) that Johnny finished his homework.'

The importance of assertion — as opposed to a question — distinguishes Korean ϕ*-ta-kes* from structures in other languages that have also been described as imposing a 'familiarity' requirement and exhibiting nominal morphosyntactic properties. For instance, Schwabe et al. (2016) citing Sudhoff (2003) show for German that a polar question is sufficient to license 'familiar' clauses, which contain the sentential proform *es*.

(15) **A:** Ist Lea krank?
is Lea ill
'Is Lea ill?'

B: Max behauptet **es**, dass sie krank ist.
Max claims it that she ill is
'Max claims it that she is ill.' (Schwabe, Frey, and Meinunger, 2016: (4))

We turn to a final restriction on ϕ*-ta-kes* when embedded by *mit* 'believe.' The prior assertion of ϕ must be familiar to the subject (attitude holder) of *mit*. It appears that the 'familiarity' requirement is satisfied if the subject of *mit* is among those to whom ϕ was asserted. In addition to [ϕ*-ta-ko*] *mit* (A1) being felicitous in this context, [ϕ*-ta-kes*] *mit* (A2) was also accepted. Here, the subject of *mit* is *Johnny's mother*, to whom ϕ was previously asserted.

(16) **A:** Johnny-ka ku-uy emma-eykey [ku-ka swukcey-lul ta ha-yess-ta-ko]
J.-NOM he-GEN mother-to he-NOM homework-ACC all do-PST-DEC-*ko*
malha-yess-ta...
say-PST-DEC
'Johnny told his mother that he finished his homework...'

A1: ...kulayse Johnny-uy emma-nun [Johnny-ka swukcey-lul ta
so J.-GEN mother-TOP J.NOM homework-ACC all
hay-ss-**ta**-**ko**] mit-e.
do-PST-DEC-*ko* believe-DEC
'...so Johnny's mother believes that Johnny finished his homework.'

A2: ...kulayse Johnny-uy emma-nun [ku-ka swukcey-lul ta
so J.-GEN mother-TOP he-NOM homework-ACC all
ha-yess-**ta**-nun **kes**-ul] mit-nun-ta.
do-PST-DEC-ADN *kes*-ACC believe-PRES-DEC
'...so Johnny's mother believes that he finished his homework.'

In discourse (17), however, only [ϕ*-ta-ko*] *mit* (B1) was accepted whereas [ϕ*-ta-kes*] *mit* (B2) was judged to be infelicitous. In this discourse, *Johnny's mother* is once again the subject of *mit* 'believe' but ϕ was not asserted previously to *Johnny's mother*: instead, ϕ was asserted to speaker A. It appears that the felicity of [ϕ*-ta-kes*] *mit* hinges on whether ϕ was asserted specifically within in the 'reported' or 'local' discourse (the one that the matrix subject participates in).

(17) **A:** Johnny told me—but hasn't said anything to his mother—that he finished all his homework. Do you believe him?

B: I don't know, but Johnny's mother went into his room and saw several completed assignments...

B1: ...kulayse Johnny-uy emma-nun [Johnny-ka swukcey-lul ta
so J.-GEN mother-TOP J.NOM homework-ACC all
hay-ss-**ta**-**ko**] mit-e.
do-PST-DEC-*ko* believe-DEC
'...so Johnny's mother believes that Johnny finished his homework.'

B2: #...kulayse Johnny-uy emma-nun [Johnny-ka swukcey-lul ta
so J.-GEN mother-TOP J.NOM homework-ACC all
ha-yess-**ta**-nun **kes**-ul] mit-e.
do-PST-DEC-ADN *kes*-ACC believe-DEC
'...so Johnny's mother believes that Johnny finished his homework.'
Comment: "I feel that Johnny's mom herself must have heard the claim that Johnny finished the homework."

In summary, whereas ϕ*-ta-ko* imposes no restrictions on discourses in which it occurs, ϕ*-ta-kes* is only felicitous under the following conditions, informally characterized:

(18) *The familiarity requirement of* ϕ*-ta-kes:*
Utterance of [ϕ*-ta-kes*] *mit* is felicitous just in case ϕ — or some utterance associated with propositional content that is consistent with ϕ — has been previously asserted in a local discourse (a discourse that includes the subject of *mit*).

In §4, we arrive at these conditions by appealing to the individual contributions of declarative marker *ta* and nominalizer *kes*. ϕ*-ta-kes* presupposes the existence of a prior assertion ϕ (or material consistent with ϕ) which is familiar to the subject of *mit*.[6]

[6]Our claim that ϕ*-ta-kes* presupposes a previous assertion event of ϕ recalls presuppositional characterizations of reportative expressions in German and Tagalog (Schenner, 2008; Fabricius-Hansen and Sæbø, 2004; Schwager, 2010). Elements like German *sollen* and Tagalog *daw* "induce a presupposition that the prejacent has been asserted" (Schwager, 2010: 238).

However, while the meanings can be described similarly, *ta-kes* differs from reportatives in at least three ways. First, whereas reportatives introduce this presupposition, the presupposition in Korean arises through semantic contributions of independent markers *ta* and *kes*, neither of which can itself be characterized as a reportative. Second, while reportatives can occur as main clauses that express assertions, Korean *ta-kes* clauses cannot (i). Third, whereas *mit* 'believe' readily embeds Korean *ta-kes* clauses, German *glauben* 'believe' is reluctant to embed reportative *sollen* (Schenner, 2008).

3.2. Comparison with response-stance verbs

Our characterization of belief attributions with a complement of shape ϕ*-ta-kes* in (18) is strongly reminiscent of previous descriptions of Cattell's (1978) response-stance verbs:

(19) *Response-stance:* Embedded clause refers to a familiar idea
Alice {agreed/admits/confirmed} that Ron called.

Authors including Cattell (1978), Hegarty (1992), de Cuba (2007), and Kastner (2015) observe that response-stance verbs embed 'familiar' complements. Hegarty suggests that this familiarity requirement is satisfied when such complements express common knowledge or a point of current discussion in the reported discourse. As (20) shows, assertions with response-stance verbs that embed ϕ cannot be followed by a denial that ϕ was previously asserted.

(20) Alice agreed/admits/confirmed [that Ron called]...
#...but no one had said that Ron called.

De Cuba (2007) and Kastner (2015) observe that Hungarian and Hebrew response-stance verbs prefer to embed clauses that exhibit nominal morphosyntactic properties, namely nominal proforms and clause-taking determiners. The same is true of Korean. The consultant readily allowed ϕ*-ta-kes* clauses to be embedded by response-stance verbs *tonguyha* 'agree' (21a), *incengha* 'acknowledge, accept' (21b), and *pwuinha* 'deny, reject' (21c). By contrast, the consultant strongly dispreferred sentences in which these verbs instead embedded ϕ*-ta-ko* clauses.

(21) a. Na-nun [Lee-ka wa-ss-**ta**-nun **kes**-ey] tonguyha-n-ta.
I-TOP L.-NOM come-PST-DEC-ADN *kes*-at agree-PRES-DEC
'I agree (with the claim) that Lee came.'

b. Na-nun [Lee-ka wa-ss-**ta**-nun **kes**-ul] incengha-n-ta.
I-TOP L.-NOM come-PST-DEC-ADN *kes*-ACC acknowledge/accept-PRES-DEC
'I acknowledge/accept the claim that Lee came.'

c. Na-nun [Lee-ka wa-ssa-**ta**-nun **kes**-ul] pwuinha-n-ta.
I-TOP L.-NOM come-PST-DEC-ADN *kes*-ACC deny/reject-PRES-DEC
'I deny/reject (the claim) that Lee came.'

4. Toward an account of reference to prior asserted content

We propose that the parallels between Korean *ta-kes* clauses and clauses with responses-stance verbs are no accident, but rather that typically volunteered-stance verbs like *mit* 'believe' take on the profile of a response-stance verb by virtue of the individual semantic contributions of *ta* and *kes*.

4.1. The contributions of *ta* and *kes*

We begin with the contribution of the declarative marker *ta*. As was first noted (to our knowledge) by S.S. Kim (2011), *ta* introduces a separate layer of embedding when found in clauses embedded under nouns, such as the relative in (22). In (22a), the clause without *ta* is translated as simply 'the rumor that Chelswu told me.' By contrast, the clause in (22b) contains *ta*, which is reflected in its translation with an additional verb of saying.

(22) a. [Chelswu-ka na-eykey allye cwu-n] somwun
C.-NOM I-DAT tell-ADN rumor
'the rumor$_i$ that Chelswu told me t$_i$'

b. [Chelswu-ka na-eykey allye cwu-ess-**ta**-nun] somwun
C.-NOM I-DAT tell-PST-DEC-ADN rumor
'the rumor$_i$ that (people say that) Chelswu told me t$_i$'
*'the rumor$_i$ that Chelswu told me t$_i$' (S.S. Kim 2011: 13a,b)

We suggest that *ta*-clauses evoke events of assertion of *p*.[7] We record this meaning as in (23):[8]

(23) $[\![\ ta_{embedded}\ ]\!] = \lambda p \lambda e.$e is an event of asserting p

Next, we consider what *kes*-clauses do independently of *ta*. We rely here on M.-J. Kim (2009). Kim (2009) offers a largely unified account of three structures that feature *kes*: internally-headed relative clause (IHRC) constructions (24a), perception constructions (24b), and factive constructions (24c).

(24) a. John-un [totwuk-i tomangka-n-un **kes**-ul] cap-ess-ta.
J.-TOP thief-NOM run.away-IMPF-ADN *kes*-ACC catch-PST-DEC.
'John caught the thief that was running away.'
(*Internally-headed relative clause (IHRC) construction*, Kim, 2009: (1))

b. John-un [totwuk-i tomangka-n-un **kes**-ul] po-ess-ta.
J.-TOP thief-NOM run.away-IMPF-ADN *kes*-ACC see-PST-DEC
'John saw (the event) of the thief running away.'
(*Perception construction*, Kim, 2009: (2))

c. John-un [totwuk-i tomangka-n-un **kes**-ul] al-ess-ta.
J.-TOP thief-NOM run.away-IMPF-ADN *kes*-ACC know-PST-DEC
'John knew (the fact) that the thief was running away.'
(*Factive construction*, Kim, 2009: (3))

[7] When *ta* is in a root clause or combined with *ko*, its semantics is not as transparent. We leave a full treatment of *ta* for future work.

[8] We treat its contribution as an entailment here, although it is possible it's a presupposition. It's hard to tell since *ta*-clauses make this contribution when embedded, and we only have examples where the embedding noun phrase carries a uniqueness presupposition, and hence determining whether the assertion component is entailed or presupposed has been challenging.

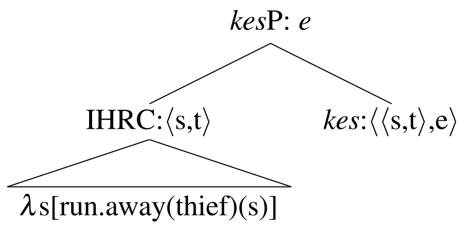
Kim (2009) proposes that *kes* introduces a salient individual or situation which stands in some contextually-supplied relation R to the proposition p. (See also Kim (2007), Hoshi (1995), and Shimoyama (1999) on IHRCs.) We adopt a version of Kim's analysis of *kes*, which departs from the original in largely trivial ways. *Kes* takes as its argument the embedded clause p (a set of situations) and returns what amounts to a definite description (25), which we characterize as a familiarity definite.[9,10]

(25) $[\![kes]\!]^C = \lambda p \iota x.R(p)(x)$
  x is in the domain of ordinary individuals or situations
  R is a suitable relation
  defined iff x is familiar in C

Kim identifies several relations that are suitable for R in different *kes*-constructions. For IHRCs, theta-relations (26) pick out an individual from the situation denoted by the embedded clause, e.g. the thief who is the agent of the running situation described in (27). The entity denoted by the entire *kes*P functions as an argument to a verb in the main clause (e.g. *caught*).

(26) a. $R_{agent} = \lambda p' \lambda x'.\exists s[p'(s) \ \&\ Agent(x')(s)]$
  b. $R_{theme} = \lambda p' \lambda x'.\exists s[p'(s) \ \&\ Theme(x')(s)]$

(27) John-un [totwuk-i tomangka-n-un **kes**-ul] cap-ess-ta.
  John-TOP thief-NOM run.away-IMPF-ADN *kes*-ACC catch-PST-DEC
  'John caught the thief that/while he was running away.'



(28) a. $[\![\ kes\ ]\!] = \lambda p \iota x.R_{agent}(p)(x)$
  $= \lambda p \iota x.[\lambda p' \lambda x'.\exists s[p'(s) \ \&\ Agent(x')(s)]](p)(x)$
  $= \lambda p \iota x.\exists s[p(s) \ \&\ Agent(x)(s)]$
  b. $[\![\ kesP\ ]\!] = \lambda p \iota x.\exists s[p(s) \ \&\ Agent(x)(s)](\lambda s'.\mathit{run\text{-}away}(\mathit{thief})(s'))$
  $= \iota x.\exists s[\mathit{run\text{-}away}(\mathit{thief})(s) \ \&\ Agent(x)(s)]$ $\rightsquigarrow$ the thief

While we must constrain the possible values for R (see below), we also want to allow it a certain flexibility. As Kim (2007) shows with (29a), R can return a sum of individuals in IHRC, each with distinct thematic roles (Kim, 2007: 8). In (29b), R returns an individual that is part of a result state described by the IHRC predicate (Grosu and Landman, 2012 after (40) in Chung and Kim (2003)).

[9]Further work is needed to determine if there is a uniqueness requirement.

[10]For Kim, *kes* takes as its argument the trace left by LF movement of the embedded clause. She also separates definiteness from *kes*, but we have built definiteness in simply for ease of exposition.

(29) a. Jinho-un [koyangi-ka cwi-lul coch-ko iss-n-un **kes**]-ul capassta.
J.-TOP [cat-NOM mouse-ACC chase-*ko* COP-IMPF-ADN *kes*]-ACC catch-PST-DEC
'A cat chased a mouse & J. caught {the cat/the mouse/the mouse & cat}.'

b. Jinho-un [paci-ka teleweci-un **kes**-ul] takkanay-ss-ta
J.-TOP pants-NOM got.dirty-ADN *kes*-ACC wipe.out-PST-DEC
'The pants got dirty and J. wiped the dirt off the pants.'

Kes-constructions arrive at factive (30) and perception (31) meanings via different values for R. Following Kim (2007) and Kratzer (2002), we treat factive complements as denoting situations that exemplify propositions; the fact-producing R (R_{fact}) in (30b) delivers this. Perception complements denote bare events—i.e. the individual situation described by the complement (Higginbotham 1983). The R found in such *kes*-clauses (31b) is simply the identity function.

(30) *Factive construction*
a. John-un [totwuk-i tomangka-n-un **kes**-ul] al-ess-ta.
J.-TOP thief-NOM run.away-IMPF-ADN *kes*-ACC know-PST-DEC
'John knew (the fact) that the thief was running away.'
b. $R_{fact} = \lambda p' \lambda x'.x'$ is a fact that exemplifies p'
(Treatment of facts after Kim (2009); Kratzer (2002))
c. $[\![kes\text{P}]\!] = \iota x.x$ is a fact that exemplifies $[\lambda s'.\textit{run-away}(\textit{thief})(s')]$

(31) *Perception construction*[11]
a. John-un [totwuk-i tomangka-n-un **kes**-ul] po-ess-ta.
John-TOP thief-NOM run.away-IMPF-ADN *kes*-ACC see-PST-DEC
'John saw (the event) of the thief running away.'
b. $R_{id} = \lambda p' \lambda s'.p'(s')$
c. $[\![kes\text{P}]\!] = \iota s.\textit{run-away}(\textit{thief})(s)$

There are questions, of course, that arise about how to constrain R. One way to constrain R would be to say that the individual x/s must refer to a (possibly non-proper) 'part' of the situation described by p: individuals in the situation, the situation itself (for perception), or the fact. We also note that the entries we give for R_{fact} and R_{id} are closely related — or identical, in the case of R_{fact} — to the denotations of complementizers given by Kratzer (2006), so there is precedent for linguistically encoding these functions.

4.2. Combining *ta* and *kes*

It is now a matter of combining *kes* with a clause that contains *ta*. (We assume the adnominal marker *un* makes no semantic contribution.) If R is valued as R_{id} as in the perception construction, then the *ϕ-ta-kes* structure simply denotes the set of assertion eventualities denoted by the *ta*-clause. For instance, the embedded clause in (32) refers to the familiar event of assertion of p in the context:

[11] Kim (2007) suggests *kes* may pick out something more like the 'image' or 'sound' of an event. We've eliminated that step for simplicity.

(32) Na-nun [$_{kesP}$ Johnny-ka swukcey-lul ta ha-yess-**ta**-nun **kes**-ul] mit-e.
I-TOP J.-NOM homework-ACC all do-PST-DEC-ADN *kes*-ACC believe-DEC
'I believe that Johnny finished his homework.'

(33) a. $[\![ta]\!]$(*that Johnny finished his homework*)
= λe.e is an event of asserting *that Johnny finished his homework*
b. $[\![kes]\!] = \lambda p \iota s.[R_{id}(p)(s)]$
c. $[\![kes\mathrm{P}]\!]([\![ta]\!]$(*that Johnny finished his homework*))
= ιs.s is an event of asserting *that Johnny finished his homework*
$\rightsquigarrow$ the event of asserting that Johnny did his homework

In §4.3, we discuss how a verb like *believe* combines with an individual event like the one in (33c). Even before doing so, however, we can already appreciate how treating *ta-kes* clauses as definite descriptions of assertion events will capture the data in §3 2–(13). When the assertion has been made in the context, it can be referred to successfully because it is familiar in the context of utterance:

(34) A: Johnny finished his homework. (=an event of asserting p)
B: ✓(32)

In (35) (an excerpt from (14)), there is no event of asserting that Johnny did his homework (only a question): as a result, *ta-kes* will not be defined and will be — as attested — infelicitous. (We return in the the next section to the additional requirement of ϕ*-ta-kes* that ϕ have been asserted within a local discourse.)

(35) A: Has Johnny done his homework? (not an event of asserting p)
B: ✗(32)

We can envision an alternative account, which would treat the contribution of *ta* as presupposition that its complement is asserted in the context, but would semantically just pass up a propositional meaning rather than introduce an event description in the object language. That presupposition would be accommodated globally when the attitude holder is a first person (utterance context participant) or locally under *believe* with a third person attitude holder. We explore this possibility in ongoing work. We do not pursue that approach here, however, because we do not see how it would account for the fact that *ta* is required for a non-factive meaning. If all *ta* did was place a presupposition on the propositional complement—that it was uttered—then modulo that presupposition, *ta-kes* clauses and *kes*-clauses under believe should behave alike. But that is not the case: as first demonstrated by Shim and Ihsane (2015), bare *kes*-clauses under *believe* are factive. The *ta* needs to make enough of a contribution to alleviate that factivity, and that is what our proposal will do.

Our proposal, however, requires further elaboration to rule out R_{fact} being used with *ta-kes* clauses under *believe*.

4.3. Response-stance *believe*

Traditionally, we think of attitude verbs as selecting propositions. By contrast, our proposal is that a *ta-kes* clause refers to an event, which is not in any obvious way what a verb like *believe* would select. In this section, we treat *ta-kes*-taking predicates as response-stance verbs in a fashion similar to the account of such verbs developed in Anand and Hacquard (2014): in their account, verbs like *claim, agree, dispute, etc.* report discourse moves whose goal is to update a reported common ground, CG_R, with the complement proposition.

(36) $[\![claim]\!]^{c,w,g} = \lambda p \lambda e.\text{claim'}(e,w) \,\&\, \forall w' \text{ compat. with Goal}(e)\ [\forall w'' \in \textsc{cg}_R(w')\ [p(w'')]]$
(Anand & Hacquard, 2014: 78)

The part of their proposal we will capitalize on is the notion of updating a reported common ground: the discourse situation that the discourse move described by the verb is a part of. We suggest that response-stance *believe* reports acceptance of (the propositional content of) of a certain discourse move into the attitude holder's belief set, where a discourse move is an event of assertion (whose own goal is to update the reported common ground). We sketch a denotation for response-stance $believe_{RS}$ in (37) which relates an attitude holder to an event of assertion e. Condition (37a) guarantees that e be uttered in the reported common ground; this accounts for the contrast in felicity between (16) and (17). Condition (37b) guarantees that e be an assertion event: the goal of e is to introduce its propositional content to the reported common ground.

(37) Sketch of denotation of Response-stance (RS) *believe*:
x $believes_{RS}$ e in a reported common ground (CG_R) in w iff:
a. e is a **discourse move** in CG_R
b. **goal**(e) is to add the CONTENT(e) to CG_R
c. DOX(x)(w) $\subset$ CONTENT(e)(w)

The notion of an event's propositional content is defined in (38b). Following Hacquard (2006) and Kratzer (2013), we take CONTENT to be a function that takes some particular with informational content (books, information sources, assertion events, belief states) and packages that informational content as a set of possible worlds. This set of worlds can then be related to the attitude holder's doxastic alternatives in standard Hintikkan fashion. The end result is that to believe an assertion event is to believe the content of that event.

(38) a. DOX(x)(w) = $\{w' : w'$ is compatible with what x believes in w$\}$
b. CONTENT(e)(w) = $\{w'$: w' is the informational content of e in w$\}$

There are many open questions that arise from this preliminary report. Among these questions is the full range of predicates that embed *ta-kes* clauses. We might predict that embedding *ta-kes* clauses under a verb of communication like *malha* 'say' would conflict with the claim being presupposed in the CG or CG_R. We also have not broached the question of what *kes*-clauses that lack *ta* mean when embedded by *believe*, e.g. (8). We described these as factive following Shim and Ihsane (2015), but remain agnostic as to whether they should be equated with knowledge ascriptions.

5. Conclusion

We set out to examine what it could mean to say that a clause "refers," taking as our focus Korean embedded clauses that bear the nominalizer *kes* and declarative marker *ta*. We suggested that they might not refer to propositions or even to propositional content directly (whatever that might be), but to assertion events that carry propositional content. Korean *ta-kes* clauses are best understood as denoting definite descriptions of an assertion event. Assertion events are easily equated with propositions, as the recent trend in projecting possible worlds from information sources ("anchors") has demonstrated

(Hacquard, 2006; Kratzer, 2013). When *ta-kes* is present, Korean *mit* 'believe' behaves like a response stance verb, reporting a discourse move: the uptake of an assertion (Anand and Hacquard 2014). The results from Korean are interesting because things could have been different: nominalized *ta-kes*-clauses instead might have referred to content that was *not* necessarily previously asserted. Both Chierchia (1984) and Asher (1993) allow propositions to denote entities, and these can be anaphorically referred to. But nothing on that view requires there be an assertion event of the proposition.

It may be useful to apply the contexts used here to other languages that have been claimed to have 'referential clauses' with nominal morphosyntactic properties. Our results reinforce the need to clearly distinguish factive from so-called 'familiar' (de Cuba, 2007), 'referential' (de Cuba and Ürögdi, 2009; Haegeman and Ürögdi, 2010), and 'presuppositional' (Kastner, 2015) clauses. When used to study embedded clauses with nominal properties in other languages, our contexts may show that such structures are best understood in terms of belief as a discourse-move reporting predicate. Preliminary results show that when Kastner's (2015) Hebrew "presuppositional clauses" (bearing demonstrative *ze*) are embedded by belief verbs (39b), they have felicity conditions similar to those of Korean *ta-kes* clauses.

(39) **Hebrew**

a. anaxnu ma'aminim [še-yeš le-xa hetkef lev].
we believe.PL COMP-is to-you.M attack.CS heart
'We believe that you are having a heart attack.'

b. anaxnu ma'aminim le-**ze** [še-yeš le-xa hetkef lev].
we believe.PL to.this COMP-is to-you.M attack.CS heart
'We believe this that you are having a heart attack.' (I. Kastner, p.c.)

(40) *Discourse A:*
A: What's wrong with me Doctor?
B: ✓(39a), ✗(39b)

(41) *Discourse B:*
A: Don't you believe me that I am having a heart attack?
B: ✓(39a), ✓(39b)

A full-scale investigation of the semantics and pragmatics of nominalized clauses is underway.

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A surface-scope analysis of authoritative readings of modified numerals[1]

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Abstract. A sentence like *You're allowed to draw at most three cards* has a so-called authoritative reading characterized by two kinds of inference: an upper-bound inference (you're not allowed to draw more than three cards) and a free-choice inference (you're allowed to draw any number of cards in the range $[0,3]$). We show that authoritative readings are available for a variety of expressions beyond just *at most*, and we provide the first (as far as we know) surface-scope account of such readings, building on the recursive exhaustification account of free-choice disjunction proposed by Fox (2007).

Keywords: modified numerals, free-choice inferences, exhaustivity, recursive exhaustification

1. The puzzle

Sentence (1) has two readings, which Büring (2008) calls a *speaker insecurity reading* (or ignorance reading) and an *authoritative reading*. On its speaker insecurity reading, the sentence conveys that the maximum number of cards you're allowed to draw is either three or fewer than three, and the speaker is ignorant about which is true. This reading can be brought out by following the sentence with *but I don't know exactly how many*.

(1) You're allowed to draw at most three cards.

We will be concerned in this paper with the authoritative reading of (1), which is characterized by two kinds of inference: (i) an *upper-bound* (UB) inference, viz. that you're not allowed to draw four or more cards, and (ii) a *free-choice* (FC) inference, viz. that you're allowed to draw any number of cards in the range $[0,3]$.[2] Authoritative readings constitute a well-known puzzle for the semantics of modified numerals (Geurts and Nouwen, 2007; Büring, 2008; Penka, 2014), which we describe in two parts.

First, on standard assumptions about the meanings of *allow* and *at most three*, a surface-scope analysis of (1) predicts a weak literal meaning, 'There is a permissible world in which you draw three cards or fewer', notated henceforth as $\diamond[\leq 3]$. Neither an UB inference ($\neg\diamond[\geq 4]$) nor a FC inference ($\diamond[=3] \wedge \diamond[=2] \wedge \ldots$) logically follows from this interpretation. Moreover, an

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2. Our empirical claim regarding FC inferences deviates from that of Penka (2014), who assumes only partial, rather than total, FC: (1) conveys only that you may draw exactly three cards and may draw fewer than three cards, not that you may draw any number of cards in the range $[0,3]$ (though the sentence is compatible with such a state of affairs). This partial view is also in line with claims about ignorance inferences, which have been argued to be partial, not total (Schwarz, 2016). We take a different stance, which is that these inferences are normally total, but in certain contexts can be partial. The system we propose will be able to account for such weakening (by 'pruning' certain alternatives from consideration), as we discuss at the end of the paper, in §4.4.

inverse-scope analysis (*at most three* > *allow*) derives only the speaker insecurity reading, and the reason for this is that when *at most three* takes widest scope, a speaker insecurity reading obligatorily emerges. For instance, (2) is incompatible with the speaker knowing exactly how many cards Ann drew; he knows it's either three or fewer than three, but is ignorant about which is true (Geurts and Nouwen, 2007; Büring, 2008; Nouwen, 2010, 2015; Schwarz, 2016).[3]

(2) Ann drew at most three cards.

Second, the antonym of *at most*, *at least*, does not give rise to authoritative readings. For example, (3) cannot be used to convey that you're allowed to draw three or more cards, with FC in the range $[3,n]$ (for some contextually specified UB n, e.g. 52, the number of cards in a standard deck), and a lower bound (LB) that prohibits drawing two cards or fewer. To see this, notice the oddity of embedding (3) under a expression like *The rules state that ...*, or of a game master uttering (3).[4]

(3) You're allowed to draw at least three cards.

To summarize, the puzzle has two parts: why does (1) have an authoritative reading, and why does (3) not have an authoritative reading? The most prominent and successful solution to this puzzle, as far as we are aware, is due to Penka (2014). She takes *at most* to be the oddity in this puzzle, and she solves it by decomposing *at most* into a negative component, *ANT*, plus *at least*, and giving (1) a split-scope analysis: *ANT three* scopes above *allow*, which in turn scopes above *at least* (hence, the scope of *at most three* is 'split').

(4) a. *at most three* $\rightsquigarrow$ *ANT* + *three* + *at least* (Penka, 2014)
b. ANT three [λn [allowed [at least n [λm you draw m cards]]]]
c. $\forall n . n > 3 \rightarrow \neg \Diamond [\geq n]$ $(\equiv \neg \Diamond [\geq 4])$

On this account, the literal meaning of (1) immediately entails an UB; FC then follows from neo-Gricean reasoning, given certain assumptions about the Horn scales responsible for generating alternatives. Together, these ingredients solve the first half of the puzzle. The second half is solved simply because *at least* has no analogous decomposition: parsing (3) with surface scope (*allow* > *at least three*) or with inverse scope (*at least three* > *allow*) leads only to an ignorance reading, not to a LB authoritative reading. (See Penka's paper for details.)

2. New observations

Penka's (2014) proposal attributes the contrast between *at most*, which gives rise to authoritative readings, and *at least*, which doesn't, to a special property of *at most*, namely that it's composed of a negative part, *ANT three*, that can take scope separately from its remainder, *at least*. We

3. There are a number of proposals for how to derive ignorance readings (e.g. Geurts and Nouwen, 2007; Büring, 2008; Nouwen, 2010; Coppock and Brochhagen, 2013; Nouwen, 2015; Schwarz, 2016). Our point here is that whichever one of these accounts one adopts, the prediction is that parsing (1) with *at most three* taking scope above *allow* will necessarily derive only an ignorance reading (not an authoritative reading) by whatever mechanism the account assumes is responsible for (2).

4. One might think that an authoritative reading of (3) is somehow 'blocked' due to competition with the more natural and straightforward sentence *You're required to draw at least three cards*. We discuss (and provide arguments against) this idea in §4.3.

now show that a variety of expressions, beyond just *at most*, give rise to authoritative readings, including both members of certain other antonym pairs.[5]

To start, (5) has a natural authoritative reading characterized by a LB inference (the catering premises may not open earlier than 5:00 AM) and a FC inference (they may open at 5:00 AM and at any time later than that).

(5) The catering premises may open at the earliest at 5:00 AM.

Similarly, (6) has a natural authoritative reading characterized by an UB inference (deductions may not occur later than the time of submission) and a FC inference (they may occur at the time of submission and at any time earlier than that).

(6) Deductions may occur at the latest at the time of submission.

Thus, unlike *at least* and *at most*, both of *at the earliest* and *at the latest* give rise to authoritative readings.[6]

Furthermore, other numeral modifiers besides *at most* can have authoritative construals. For example, (7), with *between three and seven*, has both a LB inference (the Speaker is not allowed to appoint fewer than three MPs, maybe because that one or those two MPs would hold too much power) and an UB inference (the Speaker is not allowed to appoint more than seven MPs, maybe because that would give, overall, too much power to too many MPs), as well as a FC inference (the Speaker is allowed to appoint any number of MPs in the range $[3,7]$).

(7) The Speaker is allowed to appoint between three and seven MPs to exercise his powers to issue recess writs when he is out of the country.

What's more, we find cases where *at least* actually *does* give rise to a LB authoritative reading, e.g. when conjoined with *at most*. For instance, (8c) conveys that the guild may not have fewer than three members, nor more than 100, and that it may have any number of members in the range $[3,100]$.

(8) a. You're allowed to nominate at least two and at most four authors this week!
b. Each bidder is allowed to bid for at least five lots and at most fifteen lots.
c. The guild may have at least three and at most 100 members.

Finally, we note the robust contrast in (9). In particular, while *at least* in (9a) cannot be construed authoritatively, in (9b) it can be: if you choose to write a paper, then you're not allowed to write fewer than three pages (LB inference), and you're allowed to write exactly three, four, ... pages (FC inference).

5. The examples in (5–8) come from Google and the Wikipedia corpus.
6. One potentially important difference between *at least/most* and *at the earliest/latest* is the presence of the definite determiner *the* in the latter. We're unsure exactly what role *the* plays here, but we observe that adding *the* to *at least* surprisingly improves sentences intended to be interpreted authoritatively: *(The rules state that) you're allowed to draw three cards at the least*, though not perfect, sounds much better to our ears than (3).

(9) The syllabus states that ...
  a. #You're allowed to write at least three pages.
  b. You're allowed to (either) give a presentation or (else) write at least three pages.

The LB authoritative uses of *at least* noted above are prima facie evidence against a decompositional account of the puzzle, i.e. an account that solves the puzzle by attributing a special property to *at most*.

Moreover, the availability of authoritative readings for both members of antonym pairs like *at the earliest* and *at the latest* casts doubt on a decompositional explanation of the asymmetry between *at least* and *at most*. For example, while it's possible to decompose *at the earliest* into something like 'not earlier than' and to decompose *at the latest* into something like 'not later than', doing so would undermine the explanation of the contrast between *at least* and *at most*: why not decompose *at least* into 'not fewer than'?[7]

Finally, extending the decompositional account to non-superlative expressions would require some rather ad hoc syntactic assumptions: *between three and seven* would need to decompose into something like 'not fewer than three and not more than seven'. It's unclear to us how such an approach would proceed, nor how conceptually appealing it would be.

Before concluding this section, it's important to establish that, just like for (1), an inverse-scope analysis of the above examples would not account for their authoritative readings. The reason is because, just like for *at most*, when *at the earliest*, *at the latest*, *between*, and *at least ... and at most* do not occur in the scope of an operator like *allow*, as in the examples in (10), ignorance readings obligatorily emerge, and consequently, an inverse-scope analysis would predict ignorance inferences across the board.[8]

7. To be more precise, the meaning of *ANT*, for Penka (2014), encodes the relation >: *ANT d D* (*D* a predicate of degrees) means $\neg\exists d'.d' > d \wedge d' \in D$. Presumably, this could be extended to *at the latest*, where > would refer not to the 'greater than' ordering over degrees, but to the 'later than' ordering over points (or intervals) of time: *ANT t T* (*T* a predicate of points of time) would mean $\neg\exists t'.t' > t \wedge t' \in T$. However, using *ANT* to decompose *at the earliest* wouldn't work; for that, one would need a different expression that involves the 'earlier than' relation, <. Call it $ANT_<$. The point now is that one would need a principled explanation why *at least* does not decompose into something involving $ANT_<$, which would lead to LB authoritative readings for sentences like (3). In other words, one would need to explain why *at least* is exceptional in this regard.

8. That *between* obligatorily implies ignorance (like superlative modifiers) is debatable. For instance, in his influential article on modified numerals, Nouwen (2010) classifies *at least* and *at most* as class B modifiers (they obligatorily imply ignorance when unembedded), but he classifies *between* (in contrast to *from ... to*) as class A. However, Nouwen does not devote any detailed discussion to *between*, and we think that it patterns a lot like superlative modifiers, e.g., when it comes to Nouwen's hexagon example:

(i) A hexagon has $\left\{\begin{array}{c}\text{more than three/fewer than eleven}\\ \text{\#at least four/at most ten}\\ \text{\#between four and ten}\end{array}\right\}$ sides.

Nevertheless, as Benjamin Spector points out to us, there may still be some truth to the notion that the potential ignorance inferences associated with *between* are more fragile than those associated with superlative modifiers. If so, then an inverse-scope analysis of examples like (7) might be possible after all. However, one would still need to account for the rest of our new observations. Instead, we hope to show that all the observations can be subsumed under a single account.

(10) a. Bill arrived at the earliest (latest) at 8:00 AM.
b. The Speaker appointed between three and seven MPs to excercise his powers to issue recess writs when he is out of the country.
c. Cindy nominated at least two and at most four authors.

The take-home message is that it's not *at most* which is the oddity in this puzzle, nor is it *at least*, per se. Rather, it's more specifically *at least* in just some sentences, like (3), but not (8c) or (9b). We therefore want to try to analyze all the above cases uniformly, without proposing that *at most* or any other expression has any special (non-standard) morphosyntax.

3. Proposal

3.1. Free-choice disjunction

Our starting point is to highlight some striking similarities between authoritative readings of *at most* in the scope of *allow* and FC readings of disjunction in the scope of *allow*.[9] Specifically, disjunction in the scope of an existential modal like *allow* licenses similar FC and 'bound' inferences. For example, in a context where the relevant desserts are cake, gelato, and pie, (11) licenses two inferences: (i) you're not allowed to have pie (a kind of 'bound' inference, in the sense that, as far as desserts go, you're bound to the set {cake, gelato}), and (ii) you're allowed to have cake, and you're allowed to have gelato (a FC inference) (von Wright, 1969; Kamp, 1973).[10] However, similar to what we saw for (1), a surface-scope analysis of (11) predicts a weak literal meaning, 'There is a permissible world in which you have cake or gelato' ($\diamond c \vee g$), from which neither a 'bound' inference ($\neg \diamond p$) nor a FC inference ($\diamond c \wedge \diamond g$) logically follows.

(11) You're allowed to have cake or gelato.

An influential account of FC disjunction is due to Fox (2007), who proposes that the meaning of (11) is a strengthened version of the weak surface-scope meaning $\diamond(c \vee g)$. Strengthening is due to the presence of a grammatical device, *exh*, a covert analog of *only* that is responsible for scalar implicatures (Chierchia et al., 2012). What *exh S* means is that S is true and that each 'innocently excludable' member of $\mathrm{alt}(S)$ (the set of alternatives of S) is false, where, intuitively, a proposition $q \in \mathrm{alt}(S)$ is innocently excludable (relative to $[\![S]\!]$) just in case the negation of q doesn't contradict $[\![S]\!]$ and also doesn't force any disjunction of members of $\mathrm{alt}(S)$ to be true (unless that disjunction is already entailed by $[\![S]\!]$).[11]

(12) $[\![\text{exh } S]\!] = [\![\text{exh}]\!](\mathrm{alt}(S))([\![S]\!])$,
where $[\![\text{exh}]\!](A)(p) = p \wedge \bigwedge\{\neg q : q \in \mathrm{IE}(p,A)\}$,
and $\mathrm{IE}(p,A) = \bigcap\big\{A' : A' \text{ is a maximal subset of } A \text{ s.t. } \{p\} \cup \{\neg q : q \in A'\} \text{ is consistent}\big\}$

9. Comparing superlative modifiers with disjunction is by no means a novel idea. Büring's (2008) landmark paper established an exciting line of inquiry into how to analyze the ignorance inferences associated with *at least* and *at most* by building on well-understood accounts of the ignorance inferences associated with *or*. However, to our knowledge, no one has extended this line of inquiry to analyze authoritative construals of *allow ... at most* along the same lines as that of FC construals of *allow ... or*.
10. There is, potentially, a third inference, viz. that you're not allowed to have both cake and gelato ($\neg \diamond (c \wedge g)$). We ignore this exclusivity inference henceforth, as there is no detectable analog to it when it comes to modified numerals (it's logically impossible to, e.g., draw exactly two cards and exactly three cards).
11. We write 'q is IE (relative to p and A)' to mean $q \in \mathrm{IE}(p,A)$, and we omit 'relative to p and A' when it's clear from context.

For example, suppose that alt(John ate cake or gelato) = $\{c \vee g,\ c,\ g,\ c \wedge g\}$ (Sauerland, 2004; Fox, 2007). Then, relative to $c \vee g$, neither c nor g is IE: negating c would force g to be true, and conversely, negating g would force c to be true. (While it's consistent with $c \vee g$ to negate c or to negate g, the intuition is that we can't arbitrarily pick which of c or g to negate; thus, we don't negate either one.) However, $c \wedge g$ is IE, and so $[\![$exh [John ate cake or gelato]$]\!] = (c \vee g) \wedge \neg(c \wedge g)$, i.e. the proposition that John ate cake or gelato but not both, which corresponds to the exclusive interpretation of ordinary disjunction.

Crucially, recursive application of *exh* is predicted to be possible. In a simple case like above, additional applications are vacuous, but when disjunction occurs in the scope of *allow*, recursive exhaustification is not vacuous and in fact delivers precisely the attested FC reading. To see this, consider the LF in (13). Let's start with the constituent *exh S*, and assume that $\mathrm{alt}(S) = \{\diamond(c \vee g),\ \diamond c,\ \diamond g,\ \diamond p\}$.[12] Then, relative to $[\![S]\!]$ and $\mathrm{alt}(S)$, we see that $\diamond p$ is IE, but neither $\diamond c$ nor $\diamond g$ is IE: negating $\diamond c$ would force $\diamond g$ to be true, and vice versa. Thus, $[\![\mathrm{exh}\ S]\!] = \diamond(c \vee g) \wedge \neg\diamond p$, the proposition that there is a permissible world in which you have cake or gelato, and no permissible world in which you have pie. Thus, the inner *exh* immediately derives the 'bound' inference (pie is not allowed), but not the FC inferences.

(13) exh [exh [$_S$ allowed [you have cake or gelato]]]

Let's move now from *exh S* to the entire sentence, *exh exh S*. Assume, along with Fox (2007), that alt(exh S) is the set of strengthened alternatives to S.

(14) $\mathrm{alt}(\mathrm{exh}\ S) = \{[\![\mathrm{exh}]\!](\mathrm{alt}(S))(p) : p \in \mathrm{alt}(S)\}$

Computing alt(exh S) requires computing $[\![\mathrm{exh}]\!](\mathrm{alt}(S))(p)$ for each $p \in \mathrm{alt}(S)$. This is given below.

(15) $$\mathrm{alt}(\mathrm{exh}\ S) = \left\{\begin{array}{l} [\![\mathrm{exh}]\!](\mathrm{alt}(S))(\diamond(c \vee g)), \\ [\![\mathrm{exh}]\!](\mathrm{alt}(S))(\diamond c), \\ [\![\mathrm{exh}]\!](\mathrm{alt}(S))(\diamond g), \\ [\![\mathrm{exh}]\!](\mathrm{alt}(S))(\diamond p) \end{array}\right\} = \left\{\begin{array}{l} \diamond(c \vee g) \wedge \neg\diamond p, \\ \diamond c \wedge \neg\diamond g \wedge \neg\diamond p, \\ \diamond g \wedge \neg\diamond c \wedge \neg\diamond p, \\ \diamond p \wedge \neg\diamond c \wedge \neg\diamond g \end{array}\right\}$$

Having computed alt(exh S), we are now in a position to compute $[\![\mathrm{exh}]\!](\mathrm{alt}(\mathrm{exh}\ S))([\![\mathrm{exh}\ S]\!])$, i.e. $[\![\mathrm{exh}\ [\mathrm{exh}\ S]]\!]$. It's the conjunction of $[\![\mathrm{exh}\ S]\!]$ (computed above as $\diamond(c \vee g) \wedge \neg\diamond p$) and the negation of all innocently excludable alternatives of *exh S*, i.e. the negation of the members of some subset of (15). Which subset? The answer is $\mathrm{alt}(\mathrm{exh}\ S) - \{[\![\mathrm{exh}\ S]\!]\}$, i.e. every proposition except the strengthened meaning of S is IE. Thus, the overall meaning is $[\![\mathrm{exh}\ S]\!]$ conjoined with the negation of each of these alternatives. We give the negations of all the propositions in (15) below, but for clarity's sake, we write them as material implications.[13]

12. We could also include the alternative $\diamond(c \wedge g)$, which would turn out to be IE, and its negation would deliver the exclusivity inference mentioned in fn. 10.
13. This is licit because $\neg(p \wedge \neg q \wedge \neg r) \equiv p \rightarrow (q \vee r)$.

(16) a. $\diamond(c \vee g) \rightarrow \diamond p$ (contradicts $[\![\text{exh } S]\!]$)
b. $\diamond c \rightarrow (\diamond g \vee \diamond p)$
c. $\diamond g \rightarrow (\diamond c \vee \diamond p)$
d. $\diamond p \rightarrow (\diamond c \vee \diamond g)$ (already entailed by $[\![\text{exh } S]\!]$)

Putting all the pieces together, the meaning of *exh exh S* is $\diamond(c \vee g) \wedge \neg\diamond p$ (the strengthened meaning of S, i.e. $[\![\text{exh } S]\!]$), plus the conjunction of the material implications $\diamond c \rightarrow (\diamond g \vee \diamond p)$ and $\diamond g \rightarrow (\diamond c \vee \diamond p)$. Some reflection reveals that these implications, together with $[\![\text{exh } S]\!]$, are equivalent to $\diamond c$ and $\diamond g$.[14] Thus, the overall meaning derived is the following, which is precisely the reading we wanted to derive.

(17) $[\![$exh [exh [$_S$ allowed [you have cake or gelato]]]$]\!]$

$$= \underbrace{\underbrace{\underbrace{\diamond(c \vee g)}_{\text{weak meaning}} \wedge \underbrace{\neg\diamond p}_{\text{'bound'}}}_{\text{strengthened meaning}} \wedge \underbrace{\diamond c \wedge \diamond g}_{\text{FC}}}_{\text{recursively strengthened meaning}} \qquad (\equiv \diamond c \wedge \diamond g \wedge \neg\diamond p)$$

Our proposal in a nutshell. Given the inferential (and syntactic) similarity between (1) (*You're allowed to draw at most three cards*) and (11) (*You're allowed to have cake or gelato*), our goal is to provide a surface-scope analysis of (1), whereby its weak meaning is recursively strengthened as we just saw for FC disjunction. More precisely, we propose that (1) is parsed with two applications of *exh*, which results in an authoritative reading, as schematized in (18).

(18) $[\![$exh [exh [$_S$ allowed [you draw at most three cards]]]$]\!]$

$$= \underbrace{\underbrace{\underbrace{\diamond[\leq 3]}_{\text{weak meaning}} \wedge \underbrace{\neg\diamond[\geq 4]}_{\text{UB}}}_{\text{strengthened meaning}} \wedge \underbrace{\diamond[=3] \wedge \diamond[=2] \wedge \ldots}_{\text{FC}}}_{\text{recursively strengthened meaning}}$$

The clear similarities between (17) and (18) may give the impression that a solution to (the first half of) the puzzle is straightforward. However, as we hope to show, although there is a solution in sight, it ultimately requires a conservative, but non-trivial amendment to the theory of exhaustification. We therefore proceed in three steps: first, we present what seems like a straightforward account and show the problem it faces; second, we propose an ad hoc amendment that fixes the problem; finally, we show that our amendment can be generalized in a non-stipulative way.

14. More precisely:

$$\begin{aligned} & \diamond(c \vee g) \wedge \neg\diamond p \wedge (\diamond c \rightarrow (\diamond g \vee \diamond p)) \wedge (\diamond g \rightarrow (\diamond c \vee \diamond p)) \\ \equiv\ & (\diamond c \vee \diamond g) \wedge \neg\diamond p \wedge (\diamond c \rightarrow (\diamond g \vee \diamond p)) \wedge (\diamond g \rightarrow (\diamond c \vee \diamond p)) \\ \equiv\ & (\diamond c \vee \diamond g) \wedge \neg\diamond p \wedge (\diamond c \rightarrow \diamond g) \wedge (\diamond g \rightarrow \diamond c) \\ \equiv\ & (\diamond c \vee \diamond g) \wedge \neg\diamond p \wedge \diamond c \wedge \diamond g \\ \equiv\ & \diamond c \wedge \diamond g \wedge \neg\diamond p \end{aligned}$$

3.2. *At most*: first attempt

To achieve our goal, it's necessary (and sufficient) to show that the sets of alternatives $\mathrm{alt}(S)$ and $\mathrm{alt}(\mathrm{exh}\ S)$ derived by standard means (e.g. Katzir, 2007; Fox and Katzir, 2011) deliver the right results. Demonstrating this is difficult because of the space of possible alternative sets; however, we believe that the following characterization is plausible: $\mathrm{alt}(S)$ is the set of propositions obtained by replacing *at most* with *fewer than*, *exactly*, *at least* or *more than*, plus those obtained by replacing *three* with any numeral, plus those obtained by doing both replacements simultaneously. Thus, we assume the following equality.[15]

(19) $$\mathrm{alt}(S) = \begin{array}{l} \{\diamond[<n] : n \in \mathbb{N}_0\} \\ \cup\{\diamond[\leq n] : n \in \mathbb{N}_0\} \\ \cup\{\diamond[=n] : n \in \mathbb{N}_0\} \\ \cup\{\diamond[\geq n] : n \in \mathbb{N}_0\} \\ \cup\{\diamond[>n] : n \in \mathbb{N}_0\} \end{array} = \begin{array}{l} \{\diamond[\leq n] : n \in \mathbb{N}_0\} \\ \cup\{\diamond[=n] : n \in \mathbb{N}_0\} \\ \cup\{\diamond[\geq n] : n \in \mathbb{N}_0\} \end{array}$$

The first step is to compute $[\![\mathrm{exh}\ S]\!] = [\![\mathrm{exh}]\!](\mathrm{alt}(S))([\![S]\!])$. All alternatives of the form $\diamond[=n]$ and $\diamond[\geq n]$, for $n \geq 4$, are IE. As a result, we negate all such alternatives, which immediately derives our UB. Moreover, alternatives that 'overlap' with (are compatible with) $\diamond[\leq 3]$, e.g. $\diamond[\geq 1]$, $\diamond[\leq 2]$, and $\diamond[=2]$, are not IE; for instance, negating $\diamond[=2]$ would entail the disjunction $\diamond[=0] \vee \diamond[=1] \vee \diamond[=3]$. So the first round of exhaustification delivers the following result.

(20) $$\begin{aligned}[\![\mathrm{exh}]\!](\mathrm{alt}(S))(\diamond[\leq 3]) &= \diamond[\leq 3] \wedge \neg\diamond[=4] \wedge \neg\diamond[\geq 4] \wedge \neg\diamond[=5] \wedge \neg\diamond[\geq 5] \wedge \ldots \\ &\equiv \underbrace{\underbrace{\diamond[\leq 3]}_{\text{weak meaning}} \wedge \underbrace{\neg\diamond[\geq 4]}_{\text{UB}}}_{\text{strengthened meaning}}\end{aligned}$$

Turning now to the recursive layer of exhaustification, let's continue to assume, with Fox (2007), that $\mathrm{alt}(\mathrm{exh}\ S)$ is the set of strengthened alternatives to S, repeated below from (14).

(14) $\mathrm{alt}(\mathrm{exh}\ S) = \{[\![\mathrm{exh}]\!](\mathrm{alt}(S))(p) : p \in \mathrm{alt}(S)\}$

The hope is that we now derive the desired FC inferences: $\bigwedge\{\diamond[=n] : n \in \mathbb{N}_0 \cap [0,3]\}$. However, it turns out that the FC we derive is too weak. To see why, we first need to compute $\mathrm{alt}(\mathrm{exh}\ S)$.

(21) $\mathrm{alt}(\mathrm{exh}\ S) =$
$$\begin{array}{l} \{[\![\mathrm{exh}]\!](\mathrm{alt}(S))(\diamond[=n]) : n \in \mathbb{N}_0\} \\ \cup\{[\![\mathrm{exh}]\!](\mathrm{alt}(S))(\diamond[\leq n]) : n \in \mathbb{N}_0\} \\ \cup\{[\![\mathrm{exh}]\!](\mathrm{alt}(S))(\diamond[\geq n]) : n \in \mathbb{N}_0\} \end{array} = \begin{array}{l} \{\diamond[=n] \wedge \neg\diamond[<n] \wedge \neg\diamond[>n] : n \in \mathbb{N}_0\} \\ \cup\{\diamond[\leq n] \wedge \neg\diamond[>n] : n \in \mathbb{N}_0\} \\ \cup\{\diamond[\geq n] \wedge \neg\diamond[<n] : n \in \mathbb{N}_0\} \end{array}$$

Next, we must determine which members of $\mathrm{alt}(\mathrm{exh}\ S)$ are IE relative to $[\![\mathrm{exh}\ S]\!] = \diamond[\leq 3] \wedge \neg\diamond[\geq 4]$. As before, we list all the negations as material implications.

15. We assume here that the equivalences $\diamond[<n] \equiv \diamond[\leq (n-1)]$ and $\diamond[>n] \equiv \diamond[\geq (n+1)]$ hold, i.e. that the relevant scale of numbers operative in (1) is the natural numbers. However, we believe that assuming a dense scale, as proposed by Fox and Hackl (2006), would not alter our main results.

(22) a. $\{\diamond[=n] \to (\diamond[<n] \vee \diamond[>n]) : n \in \mathbb{N}_0\}$
b. $\{\diamond[\leq n] \to \diamond[>n] : n \in \mathbb{N}_0\}$ (contradicts $[\![\text{exh } S]\!]$ when $n \geq 3$)
c. $\{\diamond[\geq n] \to \diamond[<n] : n \in \mathbb{N}_0\}$ (contradictory when $n = 0$)

We see that all the strengthened *exactly n* alternatives are IE, all the strengthened *at most n* alternatives for $n < 3$ are IE (but not for $n \geq 3$), and all the strengthened *at least n* alternatives for $n > 0$ are IE (but for $n \geq 4$, $[\![\text{exh } S]\!]$ already entails their negation). Putting all the pieces together, the meaning of *exh exh S* is $\diamond[\leq 3] \wedge \neg\diamond[\geq 4]$ (the strengthened meaning of S, i.e. $[\![\text{exh } S]\!]$), plus the conjunction of the material implications below.

(23) a. $\{\diamond[=n] \to (\diamond[<n] \vee \diamond[>n]) : n \in \mathbb{N}_0\}$
b. $\{\diamond[\leq n] \to \diamond[>n] : n \in \mathbb{N}_0 \cap [0,2]\}$
c. $\{\diamond[\geq n] \to \diamond[<n] : n \in \mathbb{N}_0 \cap [1,\infty)\}$

Some reflection reveals that these inferences, together with $\diamond[\leq 3] \wedge \neg\diamond[\geq 4]$, are equivalent to $\diamond[=0]$ and $\diamond[=3]$. In other words, the FC inference we derive for (1) is that you're allowed to draw 0 cards and you're allowed to draw exactly 3 cards, which is weaker than what we were hoping to derive: we're missing the inferences $\diamond[=1]$ and $\diamond[=2]$. We take it that this result is incorrect.[16]

3.3. *At most*: second attempt

Intuitively, the problem we just encountered is that the members of alt(exh S) are too strong, hence their negation results in inferences that are too weak. What we need is for alt(exh S) to include weaker alternatives, whose exclusion will result in stronger inferences, namely total FC.[17] Our idea is that the set of alternatives for the second *exh* includes not just all strengthened propositions taken from alt(S); rather, it includes all strengthened alternatives taken from the disjunctive closure of alt(S), notated as alt$(S)^{\vee}$. (For now, this is just a stipulation; in the next subsection, show that if we assume that sets of alternatives are always closed under disjunction, we retain our main result for recursive exhaustification without disrupting cases of non-recursive exhaustification.)

(24) $\text{alt}(\text{exh } S) = \{[\![\text{exh}]\!](\text{alt}(S))(p) : p \in \text{alt}(S)^{\vee}\}$ (cf. (14))

By allowing p in (24) to range over propositions taken from the disjunctive closure of alt(S), we introduce weaker alternatives into alt(exh S), whose exclusion turns out to derive total FC. To see this, let $p = \diamond[=0] \vee \diamond[=1] \vee \diamond[=3]$. p is not in alt(S), but it is in alt$(S)^{\vee}$. $[\![\text{exh}]\!](\text{alt}(S))(p)$, which is now in alt(exh S), is equal to $p \wedge \neg\diamond[=2] \wedge \neg\diamond[\geq 4]$. This strengthened alternative is

16. What we derive is a kind of partial FC, which is stronger than the partial FC that Penka (2014) derives (cf. fn. 2), and weaker that the total FC that we want to derive. In the oral talk version of this material, we assumed for simplicity that only the *exactly* alternatives were active, and we showed that this derives an even weaker FC inference than what we derive here: namely, that there are (at least) two distinct numbers m and n in $[0,3]$ such that $\diamond[=m]$ and $\diamond[=n]$. Again, we take this result to be incorrect.
17. This method is not a guaranteed recipe for deriving stronger inferences overall: the addition of weaker alternatives could instead introduce new symmetries (in the sense of Fox (2007)), which would result in fewer inferences overall. (Thanks to Emmanuel Chemla for stressing this point to us.) However, our amendment turns out not to do this, but instead has the desired effect.

IE relative to $\text{alt}(\text{exh } S)$ and $[\![\text{exh } S]\!]$. Its negation, which is equivalent to $p \to (\diamond[=2] \vee \diamond[\geq 4])$, and $[\![\text{exh } S]\!]$, which is $\diamond[\leq 3] \wedge \neg\diamond[\geq 4]$, jointly entail $\diamond[=2]$. Extrapolating from this example, we see that we derive $\diamond[=n]$ for every $n \in \mathbb{N}_0 \cap [0,3]$, just as desired.

Thus, the overall meaning derived for (1) is:

(25) $[\![\text{exh}]\!]\Big(\text{alt}(\text{exh } S)\Big)\Big([\![\text{exh}]\!]\big(\text{alt}(S)\big)\big([\![S]\!]\big)\Big)$

$$= \underbrace{\underbrace{\underbrace{\diamond[\leq 3]}_{\text{weak meaning}} \wedge \underbrace{\neg\diamond[\geq 4]}_{\text{UB}}}_{\text{strengthened meaning}} \wedge \underbrace{\diamond[=3] \wedge \diamond[=2] \wedge \diamond[=1] \wedge \diamond[=0]}_{\text{FC}}}_{\text{recursively strengthened meaning}}$$

3.4. Generalizing the amendment

Instead of stipulating something special about how $\text{alt}(\text{exh } S)$ is computed, we now show that our amendment can be generalized in a simple way: for *any* sentence S, we take $\text{alt}(S)$ to be closed under disjunction. Formally, if $\text{alt}'(S)$ is the set of usual alternatives of S, e.g. those derived by the algorithm proposed by Fox and Katzir (2011), then $\text{alt}(S) = \text{alt}'(S)^{\vee}$. The meaning of *exh* is the same as before, as given in (12), and in particular still refers to $\text{alt}(S)$; it's just that $\text{alt}(S)$ has been updated to be closed under disjunction.

Importantly, for a non-recursive occurrence of *exh*, this amendment makes no difference, in the sense that we don't derive stronger inferences than before. For instance, assume, for some sentence S, that $\text{alt}'(S)$ includes p and q but not $p \vee q$. Exhaustifying S now involves potentially excluding $p \vee q$, since this proposition is in $\text{alt}(S)$. However, excluding $p \vee q$ is possible ($p \vee q$ is IE) if and only if excluding both p and q is possible (p and q are both IE). And in turn, excluding $p \vee q$ is logically equivalent to excluding both p and q. Thus, we don't gain anything at this level: either p and q are both IE, in which case so is $p \vee q$, and negating the former is equivalent to negating the latter; or p and q are not both IE, in which case $p \vee q$ is not IE, and not negating both p and q is equivalent to not negating $p \vee q$. (See also Spector (2017).)

The effect only surfaces for recursive *exh*, and here's why. The overall meaning is of *exh exh S* is:

(26) $[\![\text{exh}]\!]\Big(\text{alt}(\text{exh } S)\Big)\Big([\![\text{exh}]\!]\big(\text{alt}(S)\big)\big([\![S]\!]\big)\Big)$

Again following Fox (2007), $\text{alt}(\text{exh } S)$ is the set of strengthened alternatives of S,[18] but now we get something different from before our pre-amendment set in (14). What we get is precisely what we stipulated earlier, in (24), except now we derive it as a consequence of closing *all* alternative sets under disjunction.

18. Whether this set, too, is closed under disjunction doesn't matter: closing it under disjunction doesn't result in any additional inferences, for the same reason that closing the usual alternative set under disjunction for non-recursive exhaustification doesn't matter. (At least, this is true for double exhaustification. It could, in principle, matter for triple exhaustification, i.e. for a sentence of the form *exh exh exh S*, but we don't pursue this line of inquiry here.)

(27) $$\begin{aligned}\mathrm{alt}(\mathrm{exh}\ S) &= \{[\![\mathrm{exh}]\!](\mathrm{alt}(S))(p) : p \in \mathrm{alt}(S)\}\\ &= \{[\![\mathrm{exh}]\!](\mathrm{alt}'(S)^{\vee})(p) : p \in \mathrm{alt}'(S)^{\vee}\}\\ &= \{[\![\mathrm{exh}]\!](\mathrm{alt}'(S))(p) : p \in \mathrm{alt}'(S)^{\vee}\}\\ &= (24)\end{aligned}$$

Finally, we note that closing the alternative set under disjunction allows us to assume that for (1), alt′ delivers just the *exactly* alternatives, and this is because any *at least* or *at most* alternative can be written as a disjunction of *exactly* alternatives.

(28) $$\mathrm{alt}(S) = \begin{pmatrix} \{\diamond[\leq n] : n \in \mathbb{N}_0\} \\ \cup\{\diamond[= n] : n \in \mathbb{N}_0\} \\ \cup\{\diamond[\geq n] : n \in \mathbb{N}_0\}\end{pmatrix}^{\vee} = \{\diamond[= n] : n \in \mathbb{N}_0\}^{\vee}$$

We don't claim this is in fact what alt′ does, but making this assumption will simplify discussion of other examples in §4.2.

4. Discussion

4.1. Free-choice disjunction revisited

Importantly, our amendment doesn't disrupt the analysis of FC disjunction like (11) (*You're allowed to have cake or gelato*). The reason is because, in this case, closing the alternative set under disjunction doesn't add any new IE alternatives. For example, if, as we assumed earlier, $\mathrm{alt}'(S) = \{\diamond(c \vee g), \diamond c, \diamond g, \diamond p\}$, then $\mathrm{alt}(S)$ is as follows, where the underlined alternatives are those that we gain (relative to before) by closing the set of alternatives under disjunction:[19]

(29) $$\mathrm{alt}(S) = \left\{\begin{matrix} \diamond c, & \diamond g, & \diamond p, \\ & \diamond(c \vee g) & \end{matrix}\right\}^{\vee} = \left\{\begin{matrix} & \diamond c, \quad \diamond g, \quad \diamond p & \\ \diamond(c \vee g), & \underline{\diamond(c \vee p)}, & \underline{\diamond(g \vee p)} \\ & \underline{\diamond(c \vee g \vee p)} & \end{matrix}\right\}$$

For the first round of exhaustification, none of the three new alternatives are IE, and so $[\![\mathrm{exh}\ S]\!]$ is still $\diamond(c \vee g) \wedge \neg\diamond p$. For the second round, we compute $\mathrm{alt}(\mathrm{exh}\ S)$.

(30) $$\mathrm{alt}(\mathrm{exh}\ S) = \left\{\begin{array}{l} [\![\mathrm{exh}]\!](\mathrm{alt}(S))(\diamond c), \\ [\![\mathrm{exh}]\!](\mathrm{alt}(S))(\diamond g), \\ [\![\mathrm{exh}]\!](\mathrm{alt}(S))(\diamond p), \\ [\![\mathrm{exh}]\!](\mathrm{alt}(S))(\diamond(c \vee g)), \\ \underline{[\![\mathrm{exh}]\!](\mathrm{alt}(S))(\diamond(c \vee p))}, \\ \underline{[\![\mathrm{exh}]\!](\mathrm{alt}(S))(\diamond(g \vee p))}, \\ \underline{[\![\mathrm{exh}]\!](\mathrm{alt}(S))(\diamond(c \vee g \vee p))} \end{array}\right\} = \left\{\begin{array}{l} \diamond c \wedge \neg\diamond g \wedge \neg\diamond p, \\ \diamond g \wedge \neg\diamond c \wedge \neg\diamond p, \\ \diamond p \wedge \neg\diamond c \wedge \neg\diamond g, \\ \diamond(c \vee g) \wedge \neg\diamond p, \\ \underline{\diamond(c \vee p) \wedge \neg\diamond g}, \\ \underline{\diamond(g \vee p) \wedge \neg\diamond g}, \\ \underline{\diamond(c \vee g \vee p)} \end{array}\right\}$$

The negations of all the members of $\mathrm{alt}(\mathrm{exh}\ S)$ are provided below. As before, we write the negations of all the conjunctive alternatives as material implications.

19. Note that for any two propositions p and q, $\diamond p \vee \diamond q \equiv \diamond(p \vee q)$. We use the latter form in the following set.

(31) a. $\Diamond c \rightarrow (\Diamond g \vee \Diamond p)$
b. $\Diamond g \rightarrow (\Diamond c \vee \Diamond p)$
c. $\Diamond p \rightarrow (\Diamond c \vee \Diamond g)$ (already entailed by $[\![\text{exh } S]\!]$)
d. $\Diamond(c \vee g) \rightarrow \Diamond p$ (contradicts $[\![\text{exh } S]\!]$)
e. $\underline{\Diamond(c \vee p) \rightarrow \Diamond g}$
f. $\underline{\Diamond(g \vee p) \rightarrow \Diamond c}$
g. $\underline{\neg \Diamond (c \vee g \vee p)}$ (contradicts $[\![\text{exh } S]\!]$)

Previously, we saw that (a–b), together with $[\![\text{exh } S]\!]$, amount to the FC inferences $\Diamond c$ and $\Diamond g$. Now, in addition to those, there are three potential new inferences, (e–g); however, (e) and (f), together with $[\![\text{exh } S]\!]$, again amount to $\Diamond c$ and $\Diamond g$, and (g) contradicts $[\![\text{exh } S]\!]$. Overall, then, no new inferences are derived relative to what we derived earlier.

4.2. New observations revisited

Our account extends naturally to all the new data introduced in §2. We just have to assume that the relevant *exactly* alternatives are available. (Other alternatives may also be available, but recall that, since we take the set of alternatives to be closed under disjunction, the *exactly* alternatives already generate the complete set that we're interested in; therefore, we ignore those alternatives in what follows.)

For example, the alternative set of (6) (*Deductions may occur at the latest at the time of submission*) must include the (meanings of) alternatives of the form *Deductions may occur at (exactly) t*, for some *t* in the set of points of time *T*.

(32) $\text{alt}(6) = \{\Diamond[= t] : t \in T\}^{\vee}$

This set is exactly the same as what we assumed for the alternative set of (1), except now we have points of time *t* instead of natural numbers *n*, and so it's no surprise that the results here will be the same. In particular, the first round of exhaustifying the meaning of (6) ($\Diamond[\leq \mathsf{time.of.submission}]$) will exclude all *exactly* alternatives involving times later than the time of submission, since those alternatives are all IE, while the second (recursive) round will derive FC inferences regarding all *exactly* alternatives involving times equal to or earlier than the time of submission.

Similarly, let's assume the exact same set of alternatives for (5) (*The catering premises may open at the earliest at 5:00 AM*). Then, in a completely parallel way, the first round of exhaustifying the meaning of (5) ($\Diamond[\geq \mathsf{5{:}00\ AM}]$) will exclude all *exactly* alternatives involving times earlier than 5:00 AM, since those alternatives are all IE, while the second (recursive) round will derive FC inferences regarding all *exactly* alternatives involving times equal to or later than 5:00 AM.

Finally, we turn to (7) (*The Speaker is allowed to appoint between three and seven MPs*), and assume the set of alternatives below. The first round of exhaustifying the meaning of (7) ($\Diamond[3,\ldots,7]$) will exclude all *exactly* alternatives involving numbers less than 3 or more than 7, since those alternatives are all IE (this derives both a LB and an UB), while the second (recursive) round will derive FC inferences regarding all *exactly* alternatives involving numbers in the range $[3,7]$.

(33) $\text{alt}(7) = \{\diamondsuit[=n] : n \in \mathbb{N}_0\}^{\vee}$

Examples like (8c) (*The guild may have at least three and at most 100 members*) can be analyzed in the same way.

4.3. Open problem

The reader has by now probably noticed that our account also predicts a LB authoritative reading for sentences like (3) (*You're allowed to draw at least three cards*). The reason why we derive such a reading is essentially the same as the reason why we derive the attested reading of (5) (*The catering premises may open at the earliest at 5:00 AM*): recursive exhaustification excludes *exactly* alternatives with numbers below 3, and derives FC regarding all *exactly* alternatives with numbers greater than or equal to 3.

This prediction is only partially correct. Recall the contrast in (9), repeated below.

(9) The syllabus states that ...
   a. # You're allowed to write at least three pages.
   b. You're allowed to (either) give a presentation or (else) write at least three pages.

Unfortunately, we still have no explanation for this contrast, or more generally why *at least* only sometimes has a LB authoritative reading.

A tempting explanation for why (3) has no LB authoritative reading is that it's somehow 'blocked' by the more natural, straightforward, and seemingly equivalent sentence with *required*, given in (34). One rationale would be that, all else being equal, it's more economical to use *require* than to use *allow* with recursive exhaustification.

(34) You're required to draw at least three cards.

However, we're doubtful whether a coherent and convincing story along these lines can be told, and here's why: (3) (on what would be its LB authoritative reading) and (34) are not completely equivalent. Given the infelicity of using (3) authoritatively, this non-equivalence is hard to detect, but we can observe a clear contrast when we move to *between*. Specifically, (35a), on its authoritative reading, says nothing about whether the speaker is required to appoint any MPs at all; in fact, it seems to imply that not appointing any MPs at all is a possibility (it's just that, if the Speaker decides to appoint some number of MPs, that number must fall in the range $[3,7]$). By contrast, (35b) clearly excludes the possibility of not appointing any MPs.

(35) a. The speaker is allowed to appoint between three and seven MPs.
   b. The speaker is required to appoint between three and seven MPs.

We can highlight the contrast even further with the minimally different pair of examples in (36). In particular, if one of the laws of Absurdistan is (36a), then presumably you won't be breaking the law if you have no children; it's just that, if you have children, then the number of children you have must not exceed three. By contrast, if the law is (36b), then anyone (of child-bearing age, etc.) without children is a criminal.

(36) a. In Absurdistan, you're allowed to have between one and three children.
b. In Absurdistan, you're required to have between one and three children.

The point here is that a sentence of the form *allow* ... $[m,n]$, on its authoritative reading, is not in general equivalent to *required* ... $[m,n]$ (on its strengthened, FC reading): specifically, for $m > 0$, the *allow* sentence says nothing about the 'zero' case, whereas the *required* sentence explicitly excludes it, as the *between* examples above illustrate. Moreover, for $m = 0$, judgments are clear that the resulting *allow* and *require* sentences are not only both felicitous, but also equivalent to one another, which is unexpected under a blocking account.[20]

(37) a. In Absurdistan, you're allowed to have between zero and three children. ✓
$\Leftrightarrow$
b. In Absurdistan, you're required to have between zero and three children. ✓

(38) a. Abstracts may be at most three pages long. ✓
$\Leftrightarrow$
b. Abstracts must be at most three pages long. ✓

Thus, a blocking account of the infelicity of an authoritative use of (3) that relies on semantic equivalence between the blocking sentence, (34), and the blocked sentence, (3), cannot be right, for two reasons: (3) and (34) are not actually equivalent, and cases of actual equivalence, e.g. (37a) and (37b), and (38a) and (38b), do not in fact give rise to blocking effects.[21]

4.4. Concluding remarks

We showed that authoritative readings of sentences like (1), (7), and many others can be accounted for by assuming that their weak, surface-scope meanings are recursively strengthened in the same way that weak meanings of disjunctive permission sentences like (11) are. We conclude by addressing an important question raised by our analysis.

We assumed that FC inferences are total, not partial (cf. fn. 2), and our amended system of recursive exhaustification delivers exactly this. However, there are clear cases where FC is not total. For example, (39) is a perfectly coherent two-sentence discourse, but a blind application of our proposal predicts it to be contradictory: the second sentence should entail, e.g., that you're allowed to draw exactly five cards, which contradicts the first sentence.

20. Parallel observations arise even for FC disjunction. For instance, compare (11) (*You're allowed to have cake or gelato*), which of course does not entail that you must have a dessert, and *You're required to have cake or gelato*, which does. In addition, *You're allowed to have cake or gelato or neither* and *You're required to have cake or gelato or neither* are both intuitively equivalent, but the *require* sentence does not block the *allow* sentence.

21. Because we assume that *exactly n* alternatives include *exactly* 0 alternatives (n ranges over the set $\mathbb{N}_0$, which includes 0), our account *does* exclude the 'zero' cases for sentences like (7). However, this issue can be resolved simply by assuming that a numeral like *three* cannot be replaced by *zero*, an assumption that doesn't seem too far-feteched, given the odd nature of *zero* compared to all other numerals. Note that taking this route would then mean that the authoritative reading of (1), with *at most*, does not actually entail the possibility of drawing zero cards, but is nonetheless compatible with such a state of affairs. We think that this result is adequate and that the inference that drawing zero cards is possible (to the extent that it's available) is either a contextual entailment or an implicature.

(39) You're required to draw an even number of cards. You're allowed to draw at most ten cards.

We think that our account is compatible with such observations, once we acknowledge that relevance considerations can restrict what counts as an alternative (Fox and Katzir, 2011), and/or that alternatives may, under certain conditions, be 'pruned' (Crnič et al., 2015). In this particular case, one effect of the first sentence is to rule out *exactly n* alternatives where *n* is odd.

However, as intuitive as this resolution may appear, it must be constrained in certain ways. For example, FC regarding the numeral mentioned in the sentence seems to always be available, which suggests that the corresponding *exactly* alternative must always be active. Witness the oddity of the two-sentence discourse in (40): the second sentence implies that you're allowed to draw exactly nine cards, which contradicts the first sentence.

(40) #You're required to draw an even number of cards. You're allowed to draw at most nine cards.

An obvious line to pursue is to say that if a numeral *n* is mentioned, then the *exactly n* alternative is relevant and cannot be pruned. Independent support for this approach comes from FC disjunction: each disjunct, because it's explicitly mentioned, must be a possibility, as the oddity of the following discourse illustrates.[22]

(41) #You're required to eat only green vegetables (non-green vegetables are not allowed). You're allowed to eat broccoli, spinach, or red cabbage.

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22. An important caveat: the parallelism drawn here is not perfect. In the case of FC disjunction, the non-prunable (obligatorily relevant) alternative is derived by replacing the full disjunction with a single disjunct (one of the ones mentioned); in the case of (40), the non-prunable alternative is derived by replacing *at most* with *exactly*. In some sense, the former case in more natural, insofar as the lexical material required for the alternative is fully present in the utterance (thus, the appeal to 'mentioning' is sensible), whereas in the latter case, it's not (*exactly* was not mentioned). However, both cases involve structural manipulation of the uttered sentence, and so from a formal perspective, there's little distinction between the two.

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The Vietnamese perfect[1]

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Abstract. The paper seeks to advance understanding of cross-linguistic variation in the semantics of tense and aspect by investigating the distribution and interpretation of the temporal marker *da* in Vietnamese. The study first explores the possibility of accounting for such a marker as an optional past tense. By testing this hypothesis against empirical data, this paper argues that *da* is neither a referential nor a quantificational past tense, but a perfect marker in Vietnamese. The second part of the paper provides a formal analysis of *da*. Based on *da*'s interaction with different adverbial phrases, this study suggests that *da* behaves similarly to the German perfect rather than the English perfect. The discussion relates directly to recent approaches to other languages and offers data from a superficially tenseless language to the discussion on the cross-linguistic semantic variation in 'perfect puzzle.'

Keywords: tense, aspect, Vietnamese.

1. Introduction

Vietnamese lacks obligatory overt tense morphology. Out of the blue, finite matrix clauses with temporally unmarked verbs are compatible with past and present temporal reference, and their viewpoint aspect is perfective, as illustrated in (1):

(1) Boba lam viec cho Jabba.
Boba do work for Jabba
'Boba works / worked for Jabba.'

There is nonetheless a temporal marker that one may be tempted to describe as a tense: *da*. As shown in (2), if *da* appears in the sentence in (1), that sentence appears to receive a past interpretation:

(2) Boba **da** lam viec cho Jabba.
Boba DA do work for Jabba
'Boba worked / had worked for Jabba.'

The goal of this paper is to explore the meaning of *da* and its contribution to the temporal interpretation of Vietnamese clauses. The organization of the paper is as follows. In Section 2, I present the background framework for tense and aspect, the basic data for Vietnamese temporal expressions, as well as the semantic proposed for superficially tenseless languages. Then, in Sections 3 and 4, I focus on the puzzle concerning past interpretations in Vietnamese, and show that *da* is neither a referential nor a quantificational past tense, respectively. Section 5 discusses cross-linguistic variation in the 'perfect puzzle,' and demonstrates that *da* behaves

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more similarly to the German perfect than the English one. Then, in Section 6, I propose a formal analysis of the perfect marker *da*, and demonstrate how the proposed semantics captures certain key facts. Section 7 concludes the paper.

2. Formal semantic and linguistic background

2.1. The framework

Tense and aspect are conceptualized in the framework of Reichenbach (1947) and Klein (1994). Following Reichenbach (1947), this paper assumes a three-way distinction between the utterance time (UT), the reference time (RT), and the event time (ET):

(3) a. UT: The time at which the sentence is uttered.
 b. ET: The time for which the predicate holds of the subject.
 c. RT: The time about which the claim is made.

Furthermore, following Klein (1994), this paper assumes tense express a relation between the RT and the UT. In particular, while past tense encodes the precedence relation between the two (RT $<$ UT), present tense locates the RT at the UT (RT = UT), and future tense locates the RT after the UT (RT $>$ UT). In contrast, aspect morphology contributes information regarding the relationship between the RT and the ET. An aspect is perfective when the ET is included within the RT (ET $\subset$ RT). On the other hand, an aspect is imperfective when the inclusion relation between the ET and the RT is reversed (RT $\subset$ ET).

Moreover, this study presumes the pronominal approach to the semantics of tense provided in Kratzer (1998). In this framework, the Tense (T) head, which is of type i, is proposed to be sister to the Aspect Phrase (ASPP), which denotes a property of times. As a result, the whole Tense Phrase (TP) denotes a proposition, as illustrated in (4) below:

(4) *The Syntax for Tense and Aspect in English (Kratzer, 1998):*

$$\begin{array}{c} \text{TP} \\ \langle s, t \rangle \end{array}$$
$$\begin{array}{cc} \text{T} & \text{AspP} \\ \langle i \rangle & \langle i, \langle s, t \rangle \rangle \end{array}$$

2.2. Temporal reference in Vietnamese

Given that there is no obligatory grammaticalized expressions that impose constraints on the temporal relation between the RT and the UT in Vietnamese, one may be tempted to describe Vietnamese as a superficially tenseless language. Bare verb sentences describe events that are located before or at the UT. When uttered out of the blue, such sentences are only compatible with present or past frame adverbials, as illustrated in (5):

(5) Hom qua / Bay gio / #Ngay mai Chewie bay den Endor.
yesterday / now / tomorrow Chewie fly to Endor
'Chewie flew / flies to Endor yesterday / now / #tomorrow.'

Following Matthewson's (2006) analysis of Lillooet, the non-future temporal reference observed in the Vietnamese sentences in (1) and (5) will be assumed to be contributed by a phonologically empty NONFUT tense morpheme whose semantics is shown in (6):

(6) *The Semantics for Tense in Superficially Tenseless Sentences (Matthewson, 2006):*
$[\![\text{NONFUT}_i]\!]^{g,\,c}$ is only defined if $g(i) \leq t_c$
If defined, $[\![\text{NONFUT}_i]\!]^{g,\,c} = g(i)$

Under Matthewson's (2006) analysis, the example in (5) is translated by the formula in (7):

(7) $[\![(5)]\!]^{g,\,c} = \lambda w\, \exists e$ [fly-to-Endor(e)(w) & agent(Chewie)(e)(w) & $\tau(e) \subseteq g(i)$]
(where $g(i) < t_c$)
'There is an event e of Chewie flying to Endor, whose flying τ is included in the contextually salient past time g(i).'

The semantics correctly predicts that superficially tenseless sentences like (5) are compatible only with past or present time reference. In consequence of this semantic restriction, future time reference in Vietnamese must always be marked overtly with the marker *se*, which will not be addressed in the discussion of this paper.

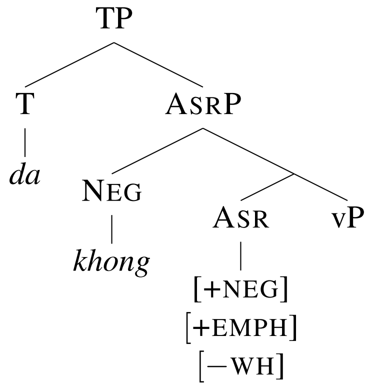
3. Not a referential past

3.1. Referential tense hypothesis

Duffield's (2007) study on the syntax of Vietnamese clausal structure claims that Vietnamese expresses assertion independently of tense or aspect. While he does not focus on the semantics of tense and aspect in Vietnamese, he does propose that Vietnamese is not a tenseless language, and that *da* is a past tense whose marking is almost always optional, which contrasts with the obligatory presence of tense morphology in English.

According to Duffield (2007), Vietnamese tense morphemes, including *da*, have the same syntactic distribution as English ones, but are without the assertion (ASR) component associated with English finite auxiliaries. As a result, Duffield (2007) suggests that the tense morphemes in Vietnamese occupy the Tense node, with lexical verbs remaining in vP, as illustrated below:

(8) *The Syntax for Tense in Vietnamese (Duffield, 2007):*



If *da* is an optional past tense morpheme realized as a Tense head, then it is expected to restrict the temporal reference of a sentence to be past. In this case, *da* requires the RT to temporally precede the evaluation time (EVALT), which is the UT in matrix clauses. Then, under the view in which Vietnamese has a referential tense system, the semantics of a temporally unmarked verb (∅) should be similar to (9a), while that of *da* should be like (9b):

(9) *The Semantics for Referential Tenses in Vietnamese:*

a. $[\![\varnothing]\!] = [\![\text{PRES}_i]\!]^{w,\, t,\, g,\, c} = [\ \lambda P_{\langle i,\, t\rangle} : \exists t'\ .\ t' = t\ \&\ P(t') = T\ ]$ ‘There is a time t’ such that t’ equals the EVALT t and P is true at t’.’

b. $[\![\text{DA}]\!] = [\![\text{PST}_i]\!]^{w,\, t,\, g,\, c} = [\ \lambda P_{\langle i,\, t\rangle} : \exists t'\ .\ t' < t\ \&\ t' \in g(i)\ \&\ P(t') = T\ ]$
‘There is a time t’ such that t’ is before the EVALT t and within the interval g(i), and P is true at t’.’

This semantics explains the difference in meaning between (1) and (2). Since *da* imposes a precedence relation between the RT and the EVALT, it plays a role in excluding the present time reference from the matrix clause in (2). Despite the fact the analysis seems to provide a satisfactory record for the contrast in (1) and (2), it still fails to account for many other data points in the language. By showing the behavior of *da* in the sequence of tense constructions in Vietnamese, I argue against the claim that *da* is a referential past tense marker.

3.2. Embedded *da* in complement clauses

Firstly, when the main verb in the matrix clause and the embedded verb in the complement clause are both temporally unmarked (Unmarked-under-Unmarked), the sentence appears to be ambiguous, allowing for either a simultaneous or a back-shifted reading, as illustrated in (10):

(10) *Unmarked-under-Unmarked in Vietnamese Complement Clauses:*

a. Nam 1980 Obi-Wan ∅ noi la Luke ∅ song o Tatooine luc do.
year 1980 Obi-Wan ∅ say that Luke ∅ live on Tatooine time that
‘In 1980, Obi-Wan said that Luke lived on Tatooine then.’
(*Lit.:* ‘In 1980, Obi-Wan says / said that Luke lives / lived on Tatooine then.’)

b. Nam 1980 Obi-Wan ∅ noi la Luke ∅ song o Tatooine nam 1977.
year 1980 Obi-Wan ∅ say that Luke ∅ live on Tatooine year 1977
'In 1980, Obi-Wan said that Luke lived on Tatooine in 1977.'
(*Lit.:* 'In 1980, Obi-Wan says / said that Luke lives / lived on Tatooine in 1977.')

This is one of the cases showing that the presence of *da* is not obligatory in Vietnamese clauses. Both the matrix and the embedded clauses can obtain the past readings with a temporally unmarked verb. Furthermore, the event in the embedded clause can be anchored at the matrix time as well as any point of time before that. This contrasts to the behaviors of referential tenses in English, as illustrated in the case of Present-under-Present sentences like (11) below:

(11) *Present-under-Present in English Complement Clauses:*

a. *In 1980, Obi-Wan **says** that Luke **lives** on Tatooine then.
b. *In 1980, Obi-Wan **says** that Luke **lives** on Tatooine in 1997.

When both of the the matrix and the embedded verbs denote present tense, the sentences are unacceptable whether the embedded time is located at or prior to the matrix time. The same behavior also shows when a past tense morpheme is embedded under a present tense matrix verb, as illustrated below:

(12) *Past-under-Present in English Complement Clauses:*

a. *In 1980, Obi-Wan **says** that Luke **lived** on Tatooine then.
b. *In 1980, Obi-Wan **says** that Luke **lived** on Tatooine in 1997.

In this case, whenever the matrix time happens before the UT in English, the matrix verb cannot be in present tense. Secondly, Vietnamese sentences in which an unmarked verb is embedded in a complement clause under *da*, which appears in the matrix clause, (Unmarked-under-*Da*), also allow for either a simultaneous or a back-shifted reading, as shown in (13):

(13) *Unmarked-under-Da in Vietnamese Complement Clauses:*

a. Nam 1980 Obi-Wan **da** noi la Luke ∅ song o Tatooine luc do.
year 1980 Obi-Wan DA say that Luke ∅ live on Tatooine time that
'In 1980, Obi-Wan said that Luke lived on Tatooine then.'
(*Lit.:* 'In 1980, Obi-Wan said that Luke lives / lived on Tatooine then.')

b. Nam 1980 Obi-Wan **da** noi la Luke ∅ song o Tatooine nam 1977.
year 1980 Obi-Wan DA say that Luke ∅ live on Tatooine year 1977
'In 1980, Obi-Wan said that Luke lived on Tatooine in 1977.'
(*Lit.:* 'In 1980, Obi-Wan said that Luke lives / lived on Tatooine in 1977.')

(13) shows that when *da* appears in the matrix clause, a temporally unmarked verb in the embedded clause can still locate the event of Luke living on Tatooine at or prior to the past matrix time. In contrary to the flexibility shown in the Vietnamese data, it is unacceptable for Present-under-Past sentences in English to have a present tense embedded verb when the ET denoted in the embedded clause occurs before the UT:

(14) *Present-under-Past in English Complement Clauses:*

a. *In 1980, Obi-Wan **said** that Luke **lives** on Tatooine then.
b. *In 1980, Obi-Wan **said** that Luke **lives** on Tatooine in 1997.

However, in English complement clauses, the interpretation of a past tense morpheme under another past tense morpheme (Past-under-Past) is ambiguous between a simultaneous reading and a back-shifted reading (Ogihara and Sharvit, 2012), as indicated in (15) below:

(15) *Past-under-Past in English Complement Clauses:*

a. In 1980, Obi-Wan **said** that Luke **lived** on Tatooine then.
b. In 1980, Obi-Wan **said** that Luke **lived** on Tatooine in 1977.

Similarly, in Hebrew, a language that makes use of referential tenses like English, Past-Under-Past sentences also allow for simultaneous readings (Ogihara and Sharvit, 2012), as shown in (16) below:

(16) *Past-under-Past in Hebrew Complement Clauses:*

Han **xasav** se Leia **ahava** oto az.
Han thought that Leia loved him then
'Han thought that Leia loved him then.'

If *da* behaves like a referential past tense, *Da*-under-*Da* sentences in Vietnamese should also allow simultaneous readings like the Past-under-Past ones in English and Hebrew. Nevertheless, in Vietnamese, sentences in which *da* is embedded under another *da* (*Da*-under-*Da*) never allows for a simultaneous reading, as shown in (17):

(17) *Da-under-Da in Vietnamese Complement Clauses:*

a. *Nam 1980 Obi-Wan **da** noi la Luke **da** song tren Tatooine luc do.
year 1980 Obi-Wan DA say that Luke DA live on Tatooine time that
'In 1980, Obi-Wan said that Luke lived on Tatooine then.'
b. Nam 1980 Obi-Wan **da** noi la Luke **da** song tren Tatooine nam 1977.
year 1980 Obi-Wan DA say that Luke DA live on Tatooine year 1977
'In 1980, Obi-Wan said that Luke lived on Tatooine in 1977.'

A *da* embedded under another *da* in complement clauses always forces a back-shifted reading. This fact suggests that *da* does not behave similarly to the referential past tenses in English and Hebrew. As a result, the possibility of *da* being a referential past tense is ruled out. The behavior of *da* in embedded contexts is further investigated with the sequence of tense cases observed in relative clauses.

3.3. Embedded *da* in relative clauses

Similarly to the Unmarked-Under-Unmarked cases in complement clauses, sentences in which unmarked verbs are present in both the matrix clause and the relative clause allow for either a simultaneous or back-shifted reading, as shown in (18):

(18) *Unmarked-under-Unmarked in Vietnamese Relative Clauses:*

a. Nam 1980 Obi-Wan ∅ gap mot nguoi ∅ song o Tatooine luc do.
year 1980 Obi-Wan ∅ meet one person ∅ live on Tatooine time that
'In 1980, Obi-Wan met a person who lived on Tatooine then.'
(*Lit.:* 'In 1980 Obi-Wan meets / met a person who lives / lived on Tatooine then.')

b. Nam 1980 Obi-Wan ∅ gap mot nguoi ∅ song o Tatooine nam 1977.
year 1980 Obi-Wan ∅ meet one person ∅ live on Tatooine year 1977
'In 1980, Obi-Wan met a person who lived on Tatooine in 1977.'
(*Lit.:* 'In 1980 Obi-Wan meets / met a person who lives / lived on Tatooine in 1977.')

Likewise, sentences in which an unmarked verb is embedded in a relative clause under a matrix verb marked with *da* are also ambiguous, allowing for either a simultaneous or back-shifted interpretation, as illustrated in (19):

(19) *Unmarked-under-Da in Vietnamese Relative Clauses:*

a. Nam 1980 Obi-Wan **da** gap mot nguoi ∅ song o Tatooine time that.
year 1980 Obi-Wan DA meet one person ∅ live on Tatooine time that
'In 1980, Obi-Wan met a person who lived on Tatooine then.'
(*Lit.:* 'In 1980, Obi-Wan met a person who lives / lived on Tatooine then.')

b. Nam 1980 Obi-Wan **da** gap mot nguoi ∅ song o Tatooine year 1977.
year 1980 Obi-Wan DA meet one person ∅ live on Tatooine year 1977
'In 1980, Obi-Wan met a person who lived on Tatooine in 1977.'
(*Lit.:* 'In 1980, Obi-Wan met a person who lives / lived on Tatooine in 1977.')

The key fact shown in (19) is that Vietnamese allows a simultaneous reading, even when *da* appears in the matrix clause. This is where an important difference between English and Vietnamese manifests itself. In particular, in English relative clauses, the availability of a simultaneous reading of the present depends on the matrix tense (Ogihara and Sharvit, 2012). In Present-under-Past sentences, a matrix past blocks a simultaneous reading, as in (20):

(20) *Present-under-Past in English Relative Clauses:*

a. *In 1980, Obi-Wan **met** a person who **lives** on Tatooine then.

b. In 1980, Obi-Wan **met** a person who **lives** on Tatooine now.

The fact that an indexical reading is allowed in (20b) shows that the time of the embedded event is required to overlap the present. In Vietnamese, however, such restriction does not exist in the relative clauses. Moreover, this availability of simultaneous readings of ∅-under-*Da* sentences in Vietnamese, a superficially tenseless language, shares parallels to the patterns observed in

Japanese, a tensed language. In particular, Japanese sentences in which a past tense morpheme in a relative clause in embedded under a present tense matrix verb also allows for both the simultaneous and indexical readings, as demonstrated in (21):

(21) *Present-under-Past in Japanese Relative Clauses:*

a. 1980-nen-ni Obi-Wan-wa Tatooine-ni sono-toki **sun-deiru** hito-ni
1980-year-DAT Obi-Wan-TOP Tatooine-DAT that-time live-PRES person-DAT
at-ta.
meet-PST
'In 1980, Obi-Wan met a person who lived on Tatooine then.'
(*Lit.:* 'In 1980, Obi-Wan met a person who lives on Tatooine then.')

b. 1980-nen-ni Obi-Wan-wa Tatooine-ni genzai **sun-deiru** hito-ni
1980-year-DAT Obi-Wan-TOP Tatooine-DAT now live-PRES person-DAT
at-ta.
meet-PST
'In 1980, Obi-Wan met a person who lives on Tatooine now.'

The behavior of the embedded *da* in relative clauses once again shows that *da* does not behave like the English past, further supporting the claim that *da* is not a referential past tense. However, the embedded *da* in Vietnamese appears to share similarities with the embedded past tense in Japanese. This pattern then raises a possibility that tenses in Vietnamese behave like those in Japanese. If this is the case, then it is plausible for *da* to be argued to function similarly to a quantificational past tense.

4. Not a quantificational past

4.1. Quantificational tense hypothesis

If tenses in Vietnamese behave like those in Japanese, then they are ambiguous, and may get quantificational interpretations (Ogihara and Sharvit, 2012). In particular, one can assume that unmarked verbs are by default interpreted in the present, and thus can have similar semantics to Japanese present tense. Meanwhile, since *da* is more temporally marked than an unmarked verb, past temporal reference is more strongly preferred. As a result, under this quantificational tense approach, the semantics of temporally unmarked verbs as well as *da* in Vietnamese is as follows:

(22) *The Semantics for Quantificational Tenses in Vietnamese:*

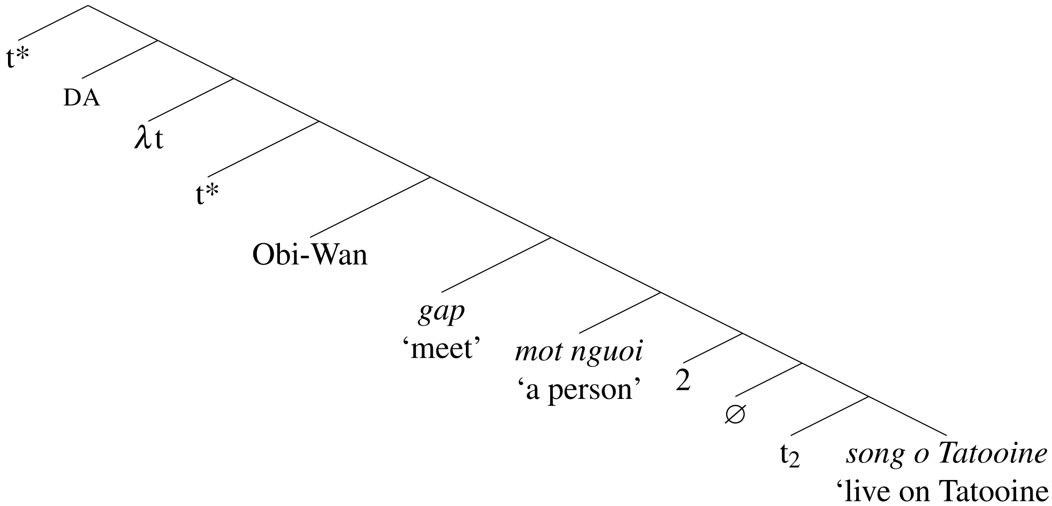
a. $[\![\varnothing]\!] = [\![\text{PRES}]\!]^{w,t,g,c} = [\, \lambda P_{\langle i,t\rangle} : [\, \lambda t' : \exists t'' \,.\, t'' = t' \,\&\, P(t'') = T \,]\,]$
'There is a time t" such that t" equals the time t' and P is true at t".'

b. $[\![\text{DA}]\!] = [\![\text{PST}]\!]^{w,t,g,c} = [\, \lambda P_{\langle i,t\rangle} : [\, \lambda t' : \exists t'' \,.\, t'' < t' \,\&\, P(t'') = T \,]\,]$
'There is a time t" such that t" is before the time t' and P is true at t".'

In this case, the quantificational tenses in (23) are of type $\langle\langle i, t\rangle, \langle i, t\rangle\rangle$. In movement of quantificational tense, the lambda created by movement is λt. Moreover, the trace of movement is [t*], which always denotes EVALT. In other words, $[\![t^*]\!]^{w,t,g,c}$ equals t. Then, the sentence in (19a) has the Logical Form (LF) structure as well as the predicted truth conditions as follows:

(23) In 1980, Obi-Wan met a person who lives / lived on Tatooine then.

a.



b. ⟦ (19a) ⟧$^{w, t, g, c}$ = $\exists$t' . t' < t & $\exists$x . x is a person in w & x lives on Tatooine in w at t' & Obi-Wan meets x in w at t'.
'There is a time t' such that t' is before the time t, and there is an x such that x is a person in world w, and x lives on Tatooine in w at t', and Obi-Wan meets x in w at t'.'

The semantics of *da* as a quantificational past tense correctly predicts that the Unmarked-Under-*Da* cases in Vietnamese relative clauses should allow for a simultaneous reading. This analysis further rejects the hypothesis that *da* is a referential past tense. In this case, the function of *da* has now been narrowed down to be either that of a quantificational past tense or a perfect. I then argue that *da* is not a quantificational tense, since not only does *da* is shown to have the ability to arrange events in a sequence but it also felicitously appears in future contexts.

4.2. Event ordering

When it comes to arranging events in a sequence, the presence of *da* is mandatory. As demonstrated in (24) below, *da* puts one event further into the past than the other. In particular, when it is uttered in the scenario described in (24), (24a) is infelicitous because it denotes that the two events occur simultaneously. On the other hand, (24b) is felicitous because *da* puts the event of R2-D2 fixing C-3PO before the event of Lando entering the room.

(24) *Context:* Lando walks into the room, and he finds R2-D2 standing next to a newly repaired C-3PO.

a. #Lando di vao phong. Chewie sua C-3PO.
Lando walk into room Chewie fix C-3PO
'Lando walked into the room. Chewie fixed C-3PO.'

b. Lando di vao phong. Chewie **da** sua C-3PO.
Lando walk into room Chewie DA fix C-3PO
'Lando walked into the room. Chewie had fixed C-3PO.'

In this case, the first sentence, which has a NONFUT tense, sets up the RT for the next sentence. *Da* then requires the second sentence to be interpreted within the past of the event of the first sentence. Then, *da* appears to function similarly to a perfect marker. Furthermore, the fact that the presence of *da* is acceptable in cases like (25) provide further evidence supporting the claim that *da* is a perfect rather than a tense.

(25) Lando di vao phong luc 2 gio. Den 2 gio 15 phut, R2-D2 **da** sua C-3PO.
Lando walk into room at 2 hour. By 2 hour 15 minute R2-D2 DA fix C-3PO
'Lando walked into the room at 2. By 2:15, R2-D2 had fixed C-3PO.'

In (25), the first sentence does not set up the RT for the sentence that follows it. In fact, it is the temporal adverbials *den 2 gio 15 phut* 'by 2:15' that sets up the RT for the second sentence. Given that *da* can combine with this adverbial phrase, it suggests that *da* does not pick out one particular point of time in the past. Rather, *da* contributes an interval of time running from one salient point in the past up until 2:15. Then, the possibility of *da* being a quantificational tense has been ruled out.

5. The 'present perfect' puzzle

5.1. Modification by 'yesterday'

In English, the present perfect is not compatible with specific past time adverbs like 'yesterday' (Pancheva and von Stechow, 2004), as demonstrated in (26) below:

(26) Luke: "Why **is** Yoda tired?"
a. Obi-Wan: "He **trained** hard yesterday."
b. Obi-Wan: *"He **has trained** hard yesterday."
c. Obi-Wan: #"He **had trained** hard yesterday."

In the scenario in which Luke asks a question like the one in (26), the only acceptable answer that Obi-Wan can utter is (26a). Since the question is put in present tense, it sets up the present time reference for the whole discourse. Since there is no past time in the discourse to impose a pluperfect interpretation, (26c) is infelicitous when uttered in this context. Meanwhile, even though the present perfect does not encounter such problem, the sentence in (26b) is still ill-formed. This problem in English, which arises due to the incompatibility between the present perfect and adverbs like 'yesterday', has been discussed in the literature as the 'present perfect puzzle'.

In order to account for the unacceptability in cases like (26b), Pancheva and von Stechow (2004) proposes three main ingredients, which are the Perfect Time Span (PTS), the perfect aspect (PERF), and the semantics for 'yesterday', as illustrated below:

(27) *The ingredients for the 'present perfect puzzle' (Pancheva and von Stechow, 2004):*

a. PTS(t', t) = t is a final subinterval for t'

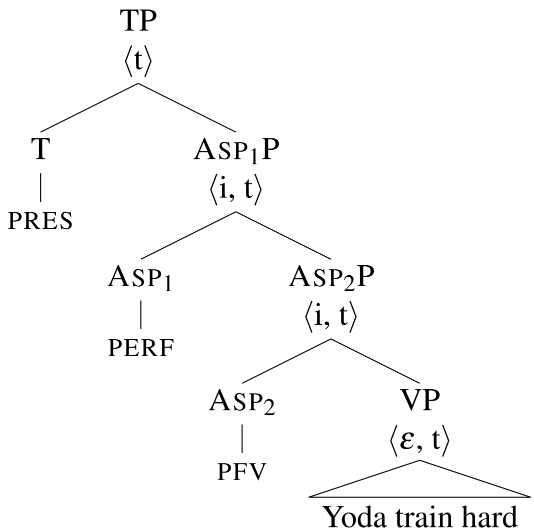
b. $[\![\text{PERF}]\!]^{w,\,t,\,g,\,c} = [\ \lambda P_{\langle i,\,t\rangle} : [\ \lambda t' : \exists t'' .\ \text{PTS}(t'', t')\ \&\ P(t')\ ]\ ]$
'There is a time t" such that t' is a final subinterval for t" and P is true at t'.'

c. $[\![\text{yesterday}]\!]^{w,\,t,\,g,\,c} = [\ \lambda t' : t' \subseteq \text{the day preceding c(time)}\ ]$
't' is a subinterval of the day preceding the context time.'

Then, the LF structure as well as the predicted truth conditions for the sentence in (26b) without the modification of the adverbial phrase 'yesterday' are as follows:

(28) Yoda trained hard.

a.



b. $[\![(26b)]\!]^{w,\,t,\,g,\,c} = \exists t' .\ \text{PTS}(t', c(\text{time}))\ \&\ \exists e .\ \text{train}(e, w)\ \&\ \text{Ag}(e, w) = \text{Yoda}\ \&\ T(e) \subseteq t'$
'There is a time t' such that the context time is a final subinterval for t', and there is an e such that e is an event of training in world w, and the agent of e is Yoda, and the time of e is a subinterval of t'.'

Given the semantics in (27), there is nowhere in (28) that the adverb 'yesterday' can be added consistently. In particular, if 'yesterday' modifies Asp_1P, its contribution is an internal contradiction, as illustrated in (29):

(29) $[\ \exists t' .\ \text{PTS}(t', c(\text{time}))\ \&\ \exists e .\ \text{train}(e, w)\ \&\ \text{Ag}(e, w) = \text{Yoda}\ \&\ T(e) \subseteq t'\ \&\ \mathbf{c(time) \subseteq the\ day\ preceding\ c(time)}\ ]$

Meanwhile, if 'yesterday' modifies Asp_2P, its contribution contradicts the statement that the context time is a final subinterval for t', as demonstrated in (30):

(30) $[\ \exists t' .\ \mathbf{PTS(t', c(time))}\ \&\ \exists e .\ \text{train}(e, w)\ \&\ \text{Ag}(e, w) = \text{Yoda}\ \&\ T(e) \subseteq t'\ \&\ \mathbf{t' \subseteq the\ day\ preceding\ c(time)}\ ]$

As a result, it is not possible to combine the present perfect with specific past time adverbials in English. However, unlike English, in Vietnamese, a sentence containing *da* can also contain 'specific' past time adverbs like *hom qua* 'yesterday,' as illustrated in (31):

(31) Hom qua Yoda **da** luyen tap cuc kho.
yesterday Yoda DA train hard
'Yoda trained hard yesterday.'
(*Lit.:* 'Yoda trained / has trained hard yesterday.')

As discussed above, because the question that Luke asks sets up the present tense for the discourse, *da* cannot be interpreted as a pluperfect. Consequently, *da* functions as a present perfect in this case. Therefore, this behavior of *da* as a perfect marker contrasts what has been observed in the English perfect. Nevertheless, this pattern of *da* is remarkably similar to the German perfect, as illustrated in (32) below:

(32) Yoda **hat** gestern hart **trainiert**.
Yoda have.3SG.PRES yesterday hard trained.PTCP
'Yoda trained hard yesterday.'
(*Lit.:* 'Yoda has trained hard yesterday.')

Similar to Vietnamese *da*, the German perfect is also compatible with specific past time adverbials like 'yesterday.' This suggests that the 'present perfect puzzle' that is present in English and other languages is absent in German and Vietnamese. As a result, *da* is more alike to the German perfect than the English one.

5.2. Interaction with 'always'

In English, even when a past tense morpheme co-occurs with the adverb 'always,' it still indicates that the event discussed is no longer true at the UT. In contrast, when the present perfect appears with the adverb 'always,' it ends up entailing that the state in question still holds at the present (Pancheva, 2004), as demonstrated in (33) below:

(33) a. Finn always **was** a Stormtroope.
b. Finn **has** always **been** a Stormtrooper.

In this case, Finn is no longer a Stormtrooper in (33a). On the other hand, (33b) entails that he is still a Stormtrooper. The semantics for (33a) and (33b) is provided in (34a) and (34b), respectively:

(34) a. $[\![\text{(33a)}]\!]^{w,t,g,c} = [\ \exists t'\ .\ \mathbf{t' < c(time)}\ \&\ \forall\ t''\ .\ t'' \in t' \rightarrow \exists e\ .\ \text{Finn-is-a-Stormtrooper}(e, w)\ \&\ T(e) \subseteq t'\ ]$
'There is an interval t' which completely precedes c(time), every subpart of which contains an eventuality of Finn being a Stormtrooper.'

b. ⟦ (33b) ⟧$^{w, t, g, c}$ = [$\exists$t' . **PTS(t', c(time))** & $\forall$t" . t" $\in$ t' $\rightarrow$ $\exists$e . Finn-is-a-Stormtrooper(e, w) & T(e) $\subseteq$ t']
'There is an interval t' which contains c(time), every subpart of which contains an eventuality of Finn being a Stormtrooper.'

The semantics in (34) correctly predicts that (33a) can be followed consistently with the phrase 'until he ran away from the First Order,' while (33b) cannot, as illustrated in below:

(35) a. Finn always **was** a Stormtrooper, until he ran away from the First Order.
b. *Finn **has** always **been** a Stormtrooper, until he ran away from the First Order.

On the other hand, besides *da*'s interaction with 'yesterday' discussed earlier, the combination between *da* and *luon* 'always' shows that the function of *da* is distinct from that of the English perfect. In particular, when *da* appears with *luon* 'always,' it does not end up entailing that the state in question also holds at the present, as illustrated in (36):

(36) a. Finn **da luon** la Stormtrooper.
Finn DA always COP Stormtrooper
'Finn has always been / had always been / always was a Stormtrooper.'
b. Finn **da luon** la Stormtrooper cho den khi no chay khoi First Order.
Finn DA always COP Stormtrooper for till when 3SG ran away First Order
'Finn always was a Stormtrooper until he ran away from the First Order.'
(*Lit.:* 'Finn has always been / had always been / always was a Stormtrooper until he runs / ran away from the First Order.')

In (36a), like English, the combination of *da* as a perfect marker and adverbials like *luon* 'always' entails that the state in question also holds at the present. Nevertheless, unlike what has been observed in the English sentence in (35b), the Vietnamese sentence in (36b) is not ungrammatical at all. In this case, the state in question only holds until the time at which Finn ran away from the First Order. The fact that sentences like (36b) are acceptable further demonstrates that *da* in Vietnamese behaves more like the German perfect, as shown in (37):

(37) Finn **ist** immer ein Sturmtruppler **gewesen** bis er vor des Ersten
Finn is.3SG.PRES always a Stormtrooper been until he from the First
Ordnung wegrannte
Order ran-away.3SG.PST
'Finn always was a Stormtrooper until he ran away from the First Order.'
(*Lit.:* 'Finn has always been a Stormtrooper until he ran away from the First Order.')

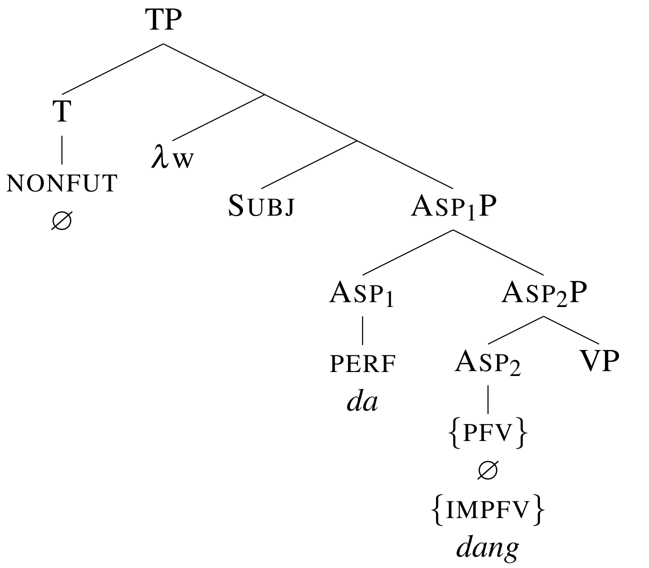
Based on the interaction of *da* with different types of adverbs such as *hom qua* 'yesterday' and *luon* 'always', it is shown that if *da* is indeed a perfect, then it shares similarities to the German perfect rather than the English perfect.

6. Formal analysis

6.1. Proposal

Based on the language data as well as the comparisons with other languages, a formal analysis for the Vietnamese perfect is proposed. Firstly, as for the syntax, a NONFUT tense morpheme occupies the head of the TP, and *da* is the head of the ASPP, as illustrated below:

(38) *The Syntax for Tense and Aspect in Vietnamese:*



Secondly, the semantics for *da* is provided below:

(39) *The Semantics for the Perfect in Vietnamese:*
$[\![\text{DA}]\!]^{w, t, g} = [\ \lambda P_{\langle i, t\rangle} : [\ \lambda t' : \exists t'' .\ t'' \leq t' \ \&\ P(t'')\ ]\ ]$
'There is an interval t" that either strictly precedes t' or has t' as a final subinterval such that P(t") = T.'

The proposed semantics captures certain key facts in Vietnamese, including the availability of simultaneous readings with complement clauses, as well as the semantic consequences of interactions with different adverbial phrases.

6.2. Availability of simultaneous readings

As mention earlier in the paper, the simultaneous reading can be obtained in Unmarked-under-*Da* in Vietnamese complement clauses, as in (13a). Meanwhile, *Da*-under-*Da* sentences like (17a) always forces a back-shifted reading. These crucial cases showing the different temporal interpretations when it comes to sequences of tense in Vietnamese are repeated below:

(40) a. Nam 1980 Obi-Wan **da** noi la Luke ∅ song o Tatooine luc do.
year 1980 Obi-Wan DA say that Luke ∅ live on Tatooine time that
'In 1980, Obi-Wan said that Luke lived on Tatooine then.'
b. *Nam 1980 Obi-Wan **da** noi la Luke **da** song o Tatooine luc do.
year 1980 Obi-Wan DA say that Luke DA live on Tatooine time that
'In 1980, Obi-Wan said that Luke had lived on Tatooine then.'

Under the proposed semantics, the contrast between these two sentences is correctly predicted. In particular, in (40a), a simultaneous reading can be obtained via a *de re* NONFUT tense. Meanwhile, in (40b), the embedded PERF *da* places the PTS t' prior to the EVALT t. The semantics of the embedded clause in (40b) is then proposed to be as follows:

(41) $[\![$ (50b) $]\!]^{w,\,t,\,g,\,c}$ = [λw' : [λt' : ∃t" . t" ≤ t' & ∃e . Luke-live-on-Tatooine(e, w') & T(e) ⊆ t"]]
'There is an interval t" which could completely precede t', every subpart of which contains an eventuality of Luke living on Tatooine.'

As a result, under this semantics, the state of being a Stormtrooper does not properly overlap the EVALT in sentences like (40b). This means that the semantics proposed for *da* correctly predicts that it is impossible to get the simultaneous reading when *da* is embedded in the lower clause.

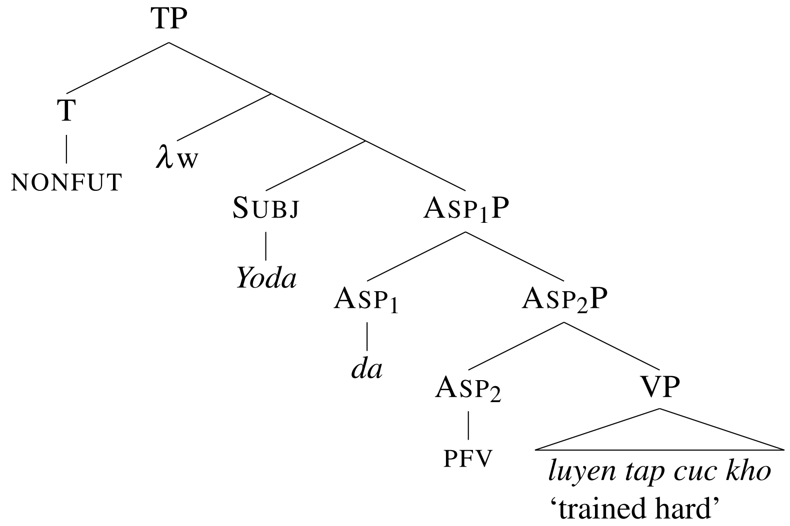
6.3. Semantic consequences of modification by 'yesterday'

Furthermore, the proposed semantics can also account for the interaction between *da* and specific past time adverbials like *hom qua* 'yesterday' (Pancheva, 2004), as shown in cases like (31), repeated as (42) below:

(42) Hom qua Yoda **da** luyen tap cuc kho.
yesterday Yoda DA train hard
'Yoda trained hard yesterday.'
(*Lit.:* 'Yoda trained / has trained hard yesterday.')

The syntax for the sentence in (42) without the modification of the adverbial phrase yesterday is as follows:

(43) Yoda has trained hard.



With the structure proposed in (43), if the adverbial phrase *hom qua* 'yesterday' modifies ASP_1P, its contribution still leads to an internal contradiction. This is because in matrix clause, the time t equals the context time, as demonstrated in (44):

(44) [∃t' . t' ≤ t & ∃e . train(e, w) & Ag(e, w) = Yoda & T(e) ⊆ t" & **t ⊆ the day preceding c(time)**]

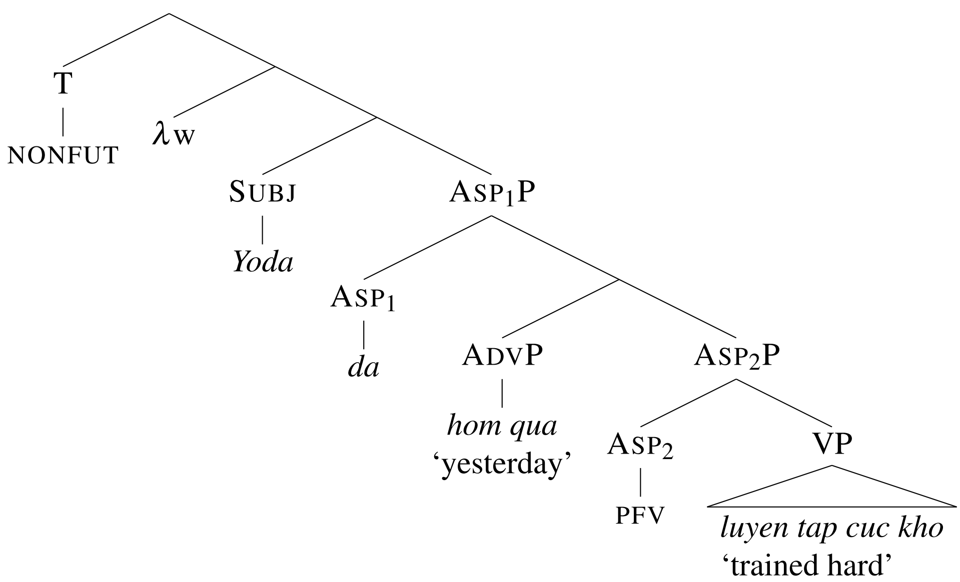
Nevertheless, if the adverbial phrase (ADVP) *hom qua* 'yesterday' modifies Asp_2P, its contribution is consistent, since it locates the PTS, and so the ET, within the day preceding the context time, as demonstrated in (45) below:

(45) [∃t' . t' ≤ t & ∃e . train(e, w) & Ag(e, w) = Yoda & T(e) ⊆ t" & **t' ⊆ the day preceding c(time)**]

Following the logic presented in (45), then the syntax as well as the predicted truth conditions for the sentence in (42) is as follows:

(46) Yoda has trained hard yesterday.

a.



b. ⟦ (52) ⟧$^{w, t, g, c}$ = [$\exists$t' . t' $\leq$ t & $\exists$e. come(e, w) & Ag(e,w) = Yoda & T(e) $\subseteq$ t' & t' $\subseteq$ the day preceding c(time)]
'There is an interval t' which could completely precede the context time t by one day, every subpart of which contains an eventuality of Yoda training hard.'

As a result, with the semantics for 'yesterday' in (27c), the proposed semantics of *da* in (39) correctly predicts that the contribution of adverbs like *hom qua* 'yesterday' is consistent.

6.4. Semantic consequences of interaction with 'always'

Lastly, the proposed semantics of *da* also captures the fact that the interaction between *da* and *luon* 'always' does not necessarily entail that the state in question holds at the present. Instead, it can just hold up until some point of time in the past, as shown in cases like (36).

Then, the semantics for (36a) is as follows:

(47) ⟦ (36a) ⟧ = [$\exists$t'. t' $\leq$ t & $\forall$t" . t" $\in$ t' $\rightarrow$ $\exists$e. Finn-is-a-Stormtrooper(e,w) & T(e) $\subseteq$ t']
'There is an interval t' which could completely precede the context time t, every subpart of which contains an eventuality of Finn being a Stormtrooper.'

The semantics in (36a) accounts for the fact that the sentence in (36b) does not entail that Finn is a Stormtrooper now.

7. Conclusion

In this study, I have investigated the behavior of the morpheme *da* in both matrix and embedded contexts, and argued that *da* in Vietnamese functions similarly to neither a referential past tense in English nor a quantificational one in Japanese. Then, based on the role it plays in a sequence of events, I have concluded that *da* in Vietnamese is a perfect marker.

Furthermore, after examining *da*'s interaction with different adverbial phrases, I suggested that *da* is more alike to the German perfect than the English perfect. This discussion relates directly to recent approaches to other languages such as English or German, and contributes data from Vietnamese to the discussion on the semantic variation on the 'present perfect puzzle' across languages.

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Loose talk, negation and commutativity: A hybrid static-dynamic theory[1]

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Abstract. This paper investigates the interaction of phenomena associated with loose talk with embedded contexts. §1 introduces core features associated with the loose interpretation of an utterance and presents a sketch of how to theorise about such utterances in terms of a relation of 'pragmatic equivalence'. §2 discusses further features of loose talk arising from interaction with 'loose talk regulators', negation and conjunction. §§3-4 introduce a hybrid static/dynamic framework and show how it can be employed in developing a fragment which accounts for the data surveyed in §§1-2.

Keywords: loose talk, order effects, dynamic semantics, pragmatic equivalence, inexactness, granularity, imprecision, slack regulators, non-literal language use.

1. Introduction: Loose talk phenomena

Loose talk is an example of the non-literal use of language. In cases of loose talk, the **communicated content** of an utterance (i.e., the proposition with which a hearer can be expected to update their doxastic state) deviates from its **literal content** (i.e., the proposition corresponding to the truth conditions of the utterance). Relatedly, the conditions under which the uttered sentence is true can differ from the conditions under which an utterance of that sentence is felicitous.

This paper examines a number of ways in which the communicated content and felicity conditions of loose utterances interact with operators and logical connectives in English. In particular, it is argued that, while sensitive to conversational context, the communicated content of such utterances can be derived compositionally in a dynamic framework and is dependent upon aspects of the lexical meaning of constituent expressions which outstrip their contribution to truth conditions.

An utterance of (1) in its specified context can be expected to exhibit loose talk phenomena.

(1) The British Library owns 14 million books.
Context.1: The interlocutors are trying to determine roughly how many books are owned by a range of major world libraries.
Circumstances.1: The British Library owns (approximately) 13,950,000 books.[2]

In *Context.1*, the communicated content of (the utterance of) (1) will be a proposition true iff the number of books owned by the British Library falls within some non-trivial interval of 14 million. Whereas the literal content of the utterance will be false if the British Library in fact

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[2] *British Library thirty-seventh annual report and accounts 2009/10.*
⟨https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/247725/0153.pdf⟩

owns 13,950,000, its communicated content will be true. Similarly, the utterance of (1) in *Context.1* and *Circumstances.1* appears felicitous, despite the falsehood of its literal content.

1.1. Pragmatic equivalence

The degree to which the communicated content of a loose utterance differs from its literal content depends, in part, upon the conversational interests of the interlocutors. In *Context.1*, since the conversational participants are trying to determine only roughly how many books each major library owns, (1) can be expected to communicate a proposition which is true if it owns 13,950,000 books. In contrast, let *Context.2* be a context in which the conversational participants are trying to determine whether the British Library owns more books than the Library of Congress, which owns, say, 13,990,000. In *Context.2*, the proposition communicated by (1) can be expected to be false.

Say that two worlds are pragmatically equivalent at a context iff they do not differ in any way which is relevant to the conversational interests of the interlocutors. For example, at *Context.1*, a world in which the BL owns 13,950,000 and one in which it owns 14 million will be pragmatically equivalent. In contrast, at *Context.2*, they will not, since the worlds differ with respect to a state of affairs relevant to the interlocutors' interests, namely whether the BL owns more books than the Library of Congress. Pragmatic equivalence can be expected to be reflexive and symmetric, but need not be transitive. No world differs from itself in ways which are pragmatically relevant, and if w does not differ from w' in any way which is pragmatically relevant, then w' does not differ from w in any way which is pragmatically relevant. However, w may differ from w'' in ways which are pragmatically relevant, despite being pragmatically equivalent to some w' which is itself pragmatically equivalent to w''; pragmatically irrelevant differences can add up to form a pragmatically relevant difference.

Given the relation of pragmatic equivalence, we can outline an approach to thinking about the communicated content and felicity conditions of loose utterances of simple sentences such as (1). A loose utterance of a simple sentence φ is felicitous at a context C and world w iff there is some world pragmatically equivalent to w at C at which the literal content of φ is true.[3] At any world in which the BL owns 13,950,000 books, a loose utterance of (1) would be felicitous at *Context.1*, but infelicitous at *Context.2*. Stated succinctly, a loose utterance of a simple sentence is felicitous iff any difference between the world of utterance and one in which the sentence is true is pragmatically irrelevant.

Correspondingly, a loose utterance of a simple sentence φ at a context C and world w communicates the proposition true at all worlds w' such that there is some world pragmatically equivalent to w' at which the literal content of φ is true. If determining the number of books owned by major libraries were exhaustive of the conversational interests in *Context.1*, then (1) might be expected to communicate the proposition that the number of books the BL owns is between 13.5×10^6 and 14.5×10^6. Likewise, if determining whether the

[3] Strictly speaking, only the left-to-right direction of the biconditional is true, since other conditions on felicity unrelated to loose talk might fail to be satisfied. For present purposes, we can treat the biconditional as embedded under a *ceteris paribus* clause.

British Library or the Library of Congress owns more books were exhaustive of the conversational interests in *Context.2*, then (1) might be expected to communicate the proposition that the number of books owned by the BL exceeds 13,990,000.

For simple sentences, the truth of φ at a world pragmatically equivalent to the world of utterance appears necessary and sufficient for both the felicitous utterance of φ and the truth of that utterance's communicated content. However, as §2 demonstrates, the same generalisations cannot be extended to account for the loose utterance of complex constructions.

2. Loose talk: Further data

2.1. LT-regulators

As has been noted elsewhere (Lasersohn, 1999; Sauerland and Stateva, 2011; Solt, 2014; a.o.), there exist a range of expressions which function lexically to modify the relation between the communicated and literal contents of loose utterances. Call such expressions **loose talk (LT-) regulators**.[4] The class of LT-regulators can be subdivided into **LT-strengtheners** (e.g., 'exactly' in (2a)) and **LT-weakeners** (e.g., 'roughly' in (2b)).

(2) a. The British Library owns <u>exactly</u> 14 million books.
b. The British Library owns <u>roughly</u> 14 million books.

As Lasersohn notes, in contrast to (1), when uttered in context the communicated contents of sentences like (2a)-(2b) coincide with their literal content (1999: 545). The communicated content of an utterance of (2a) is strictly stronger than (i.e. asymmetrically entails) the communicated content of (1) and the utterance is, intuitively, infelicitous if the BL owns less than 14 million books. In contrast, the literal content of (2b) is strictly weaker than (i.e., asymmetrically entailed by) the literal content of (1), and the utterance is, intuitively, true if the BL owns 13,950,000 books. Stated informally, the effect of the LT-strengthener in (2a) is to assimilate the communicated content of the utterance to its literal content, whereas the effect of the LT-weakener in (2b) is to assimilate the literal content of the utterance to its communicated content.[5] Note that 'exactly' also appears to have an effect on the truth-conditional meaning of numerical determiners, making them 'upper-bounded'. For present purposes, this effect can be set aside. Note that despite differing in felicity, both (1) and (2a) communicate a literal content which is false in *Circumstance.1*, regardless of whether the numerical determiner is upper-bounded. Hence the effect of LT-strengtheners on numerical determiners is clearly not exhausted by their truth-conditional contribution.

As the contrast between (3a-b) suggests, LT-regulators such as 'exactly'/'roughly' do not function as sentential operators, but rather take sub-clausal complements:

[4] Lasersohn uses the terminology 'slack regulators' whereas Solt, following Sauerland and Stateva, adopts 'approximators'.

[5] LT-weakeners also appear to have a non-trivial effect on the communicated content of loose talk utterances. For example, the communicated content and felicity of (ia-b) differ:

(i) a. ?? The British Library does not own exactly 14 million books, but it does own 14 million.
b. The British Library does not own exactly 14 million books, but it does own roughly 14 million.

(3) a. Exactly/roughly 100 libraries own 1 million books.
b. 100 libraries own exactly/roughly 1 million books.

This suggests that whatever treatment of LT-regulators is developed, it will need to account for the contrast between (3a-b) compositionally, in terms of the difference in constituent structure.

In (2a-b), the LT-regulator combines with numerical determiner '14 million'.[6] However, we can also identify apparent LT-regulators taking quantified DPs (e.g. (4b)), PPs (e.g., (5b)), adjectives/APs (e.g. (6b)), and temporal NPs (e.g. (7b)) as complements.

(4) a. Everybody likes the new Scorsese film.
b. Absolutely/pretty much everybody likes the new Scorsese film.

(5) a. The helicopter landed in the centre of the field.
b. The helicopter landed precisely/roughly in the centre of the field.

(6) a. The bin is full.[7]
b. The bin is completely/effectively full.

(7) a. Katja arrived at 6pm.
b. Katja arrived at exactly/roughly 6pm.

Correspondingly, the potential for contrast in felicity between utterances of (4-7a) and (4-7b) suggests that, in appropriate contexts, (4-7a) all permit a loose interpretation.

While many of the features of loose talk and LT-regulators addressed above have been discussed in previous work, most notably in Lasersohn (1999), little attention has been paid

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[6] The ability of 'exactly' and 'roughly' to combine with numerical determiners as in (3a) might be thought to motivate an analysis on which they take '6' as their complement in (2a-b), before combining with 'pm' to form a temporal NP. On this account, 'exactly'/'roughly' could be understood as univocally taking numerical arguments. However, constructions such as (i) demonstrate the possibility of their combining directly with temporal NPs, and suggest that they are equivocal across (3a-b).

(i) Katja arrived at exactly/roughly the same time as Jonas.

[7] Here I follow Kennedy (2007) and Kennedy and McNally (2005) in assuming that, as constructions such as (i) suggest, absolute gradable adjectives such as 'full' require their subject to possess a maximal degree of the relevant property.

(i) ??The bin is full but it could be more full.

They argue that the possibility of felicitously of predicating such adjectives of subjects with only a close-to-maximal degree of the relevant property then needs to be explained in terms of loose talk. Correspondingly, in (6b) and (ii), 'completely' will need to be understood as an LT-regulator rather than a degree modifier. Similar examples with non-gradable adjectives can be constructed (as in (iii)):

(ii) The bin is full but it is not completely full.
(iii) The result is (effectively) unprecedented, but it is not completely unprecedented.

to their behaviour in complex constructions. §2.2-3 survey novel phenomena involving the interaction of loose talk with negation and conjunction.

2.2. Negation

As uttered in context, the communicated content of (1) is asymmetrically entailed by its literal content. This has frequently been taken to be amongst the defining features of loose talk (Lasersohn, 1999; Yablo, 2014; Lauer, 2012; though cf. Davis, 2007: 411). For example, Lauer claims that “loose talk is a phenomenon in which the communicated content is weaker than the semantic content” (p. 389).

However, the loose utterances of sentences embedded under negation generate counter-examples to this claim.[8] If the communicated content of an utterance of φ is *weaker* than its literal content, the communicated content of an utterance of $\neg\varphi$ will be *stronger* than its literal content.

(8) The British Library doesn’t own 14 million books.[9]

In *Context.1*, the communicated content of (the utterance of) (8) is a proposition true iff the number of books owned by the BL does not fall within some non-trivial interval of 14 million. Whereas the literal content of the utterance will be true if the library owns 13,950,000 books, its communicated content will, plausibly, be false. Similarly, whereas in *Context.1*, an utterance of (1) is felicitous despite being false, in the same context, an utterance of (8) will be infelicitous but true.

The observed effect of negation suffices to demonstrate that the explanation of communicated content/felicity conditions for loose utterance of simple sentences in terms of literal truth at a pragmatically equivalent world cannot be trivially generalised to the utterance of sentences embedded under negation. There if the BL owns 13,950,000 books, then there is a world pragmatically equivalent at *Context.1* to *w* in which the literal content of (8) is true (since every world is trivially pragmatically equivalent to itself). Nevertheless, under these

[8] Not all counter-examples to the claim involve negation, and not all utterances of sentences embedded under negation constitute counter-examples to the claim. The communicated content of loose utterances of sentences such as (ia-b) involving minimal standards gradable adjectives will be strictly stronger than their literal content (in an appropriate context):

(i) a. The stick is curved.
b. The road is wet.

Correspondingly, the communicated content of loose utterances of their negations will be strictly weaker than the literal content.

[9] The same effect can be elicited in other constructions which exhibit loose talk phenomena in appropriate contexts:

(i) Not everybody likes the new Scorsese film.
(ii) The helicopter did not land in the centre of the field.
(iii) The bin is not full.
(iv) Katja did not arrive at 6pm.

circumstances its utterance would be infelicitous in *Context.1* and its communicated content false.

2.3. Commutativity

The felicity of loose utterances of certain conjunctive sentence is dependent upon to order of the conjuncts. Whereas (9a) is felicitous in any context in which the LH-conjunct has a true communicated content but a false literal content, (9b) is infelicitous in every context.

(9) a. The British Library owns 14 million books, though it does not own exactly 14 million.
b. ??The British Library does not own exactly 14 million books, though it does own 14 million.[10]

We can describe this phenomenon by saying that conjunction fails to commute with respect to the felicity of loose utterances. The felicity of a loose utterance of $\varphi \wedge \psi$ does not entail the felicity of a loose utterance of $\psi \wedge \varphi$.

§3, below, introduces a framework in which to theorise about loose talk, employing both a static and dynamic interpretation function. §4 presents a fragment in this framework and shows how it accounts for the phenomena in §2.

3. Dynamic Loose Talk (DLT)

3.1 Overview

This section presents a hybrid static-dynamic framework for theorising about loose talk. The primary idea behind the framework is that the lexically encoded meaning of a loose utterance of a sentence is not exhausted by its truth conditions. For example, (1) and (2a) have the same **truth conditions**, but they differ in total **compositional meaning**. In addition to explaining the difference in their felicity conditions/communicated content, this difference in meaning can account for the difference in the effect they have in embedded contexts, as demonstrated in (8) and (9a-b).

[10] The same effect can be elicited in constructions with LT-regulators taking expressions of different lexical categories:

(i) a. Everybody, but not absolutely everybody, likes the new Scorsese film.
b. ?? Not absolutely everybody, but everybody, likes the new Scorsese film.

(ii) a. The helicopter landed in the centre of the field but it did not land precisely in the centre.
b. ?? The helicopter did not land precisely in the centre of the field, but it landed in the centre.

(iii) a. The bin is full, but it is not completely full.
b. ?? The bin is not completely full, but it is full.

(iv) a. Katja arrived at 6pm, but she did not arrive at exactly 6pm.
b. ?? Katja did not arrive at exactly 6pm, but she arrived at 6pm.

This idea can be seen as analogous to observations made in dynamic treatments of anaphora (e.g., Kamp, 1981; Heim, 1982, 1983; Roberts, 1989; Groenendijk and Stokhof, 1991a; a.o.), modals (e.g., Veltman, 1996; Roberts, 1989; Groenendijk and Stokhof, 1991b; a.o.) and presupposition (Karttunen, 1973; Heim, 1983; a.o.). For example, on the basis of the contrast between (10a-b), Heim concludes that "the salience-shifting potential of an utterance is not predictable from its truth-conditions and the surrounding circumstances alone" (1982, 22).

(10) a. I dropped ten marbles and found all of them, except for one. It is probably under the sofa.
b. I dropped ten marbles and found only nine of them. ??It is probably under the sofa.[11]

That is, in (10a-b) the first sentences of the discourses are truth-conditionally equivalent, but differ in meaning.

In the Dynamic Loose Talk (DLT) framework, every utterance of a sentence is treated as playing a dual role: (i.) it expresses a proposition, corresponding to its literal content; and (ii.) it modifies, potentially trivially, the relation of pragmatic equivalence at the context. Since the effect of an utterance on the relation of pragmatic equivalence is not a function of its literal content, it must be included independently as an additional part of the lexically encoded meaning of the sentence uttered.[12]

A DLT-model contains two interpretation functions: a static interpretation function $[\![\cdot]\!]$, mapping a sentence to its literal content, and a dynamic interpretation function $[\cdot]$, mapping it to its effect on a context. The static denotation of a sentence is a **proposition** – a function from worlds to truth values. The dynamic denotation of a sentence is a **context change potential** - a function from contexts to contexts. In DLT, a context C is identified with an **accessibility relation** R^C – a relation between worlds. Intuitively, $\langle w,w'\rangle \in R^C$ iff w' is pragmatically equivalent to w in C.

Sentences are evaluated in DLT relative to a pair $\langle w,R\rangle$ consisting of world and accessibility relation. Where $[\![\varphi]\!](w)=1$, we say that φ is **true-at-**$\langle w,R\rangle$. Where $R[\varphi](w)$ is non-empty, we say that φ is **consistent-at-**$\langle w,R\rangle$. Stated alternatively, a sentence is consistent-at-$\langle w,R\rangle$ iff $R[\varphi]$ – the result of updating R with $[\varphi]$ – relates w to at least one world. An utterance of φ is held to be **felicitous** in a conversation C and world w iff φ is consistent-at-$\langle w,R^C\rangle$. The communicated content of a sentence φ at R is (the characteristic function of) the set of worlds at which φ is consistent relative to R.

3.2. DLT-models

The set T of DLT-types is defined recursively from basic types s, e, and t (corresponding to worlds, individuals and truth-values, respectively).

[11] Attributed to Partee, p.c., Heim (ibid).

[12] Grice's non-detachability constraint, which states that any content conveyed in a non-conventionalised manner by an utterance must be conveyed by any utterance with the same conventionalised meaning (with a proviso for implicatures generated by Manner) (1975, 43-6), can be seen as articulating this point.

(DEF.1) s, e, and t are **DLT-types**. If τ,τ' are **DLT-types**, then $\langle\tau,\tau'\rangle$ is a **DLT-type**. Nothing else is a DLT-type.

A DLT-model $\mathcal{M}$ is a tuple consisting of a set $\mathcal{D}^{\mathcal{M}}$ of domains of each **DLT-type**, plus static and dynamic interpretation functions, $[\![\cdot]\!]^{\mathcal{M}}$ and $[\cdot]^{\mathcal{M}}$, which map a set $\mathcal{L}$ of expressions into the corresponding domain. Indexation to a model is disregarded where no confusion arises.

(DEF.2) $\mathcal{M}=\langle\mathcal{D}, [\![\cdot]\!],[\cdot]\rangle$ is a **DLT-model**, s.t.:
- $\mathcal{D}=\bigcup\{\mathcal{D}_\tau: \tau\in T\}$
  - $\mathcal{D}_s$, $\mathcal{D}_e$ and $\mathcal{D}_t$ are pairwise disjoint non-empty sets.
  - $\mathcal{D}_t=\{0,1\}$.
  - $\mathcal{D}_{\langle\tau,\tau'\rangle}= \mathcal{D}_\tau \rightarrow \mathcal{D}_{\tau'}$.
- $[\![\cdot]\!]: \mathcal{L}\rightarrow\mathcal{D}$.
- $[\cdot]: \mathcal{L}\rightarrow\mathcal{D}$.

Contexts are identified with **accessibility relations.**

(DEF.3) Let $\langle s\langle s,t\rangle\rangle=\sigma$.
- $R,R',\ldots\in\mathcal{D}_\sigma$ are **accessibility relations**.

(DEF.4) Where $\varphi\in\mathcal{L}$ is a **sentential expression**:
- $[\![\varphi]\!]\in\mathcal{D}_{\langle s,t\rangle}$
- $[\varphi]\in\mathcal{D}_{\langle\sigma,\sigma\rangle}$.

The static denotation of a **sentential expression** $\varphi\in\mathcal{L}$ is a **proposition** – a function from worlds to truth values. The dynamic denotation of a **sentential expression** $\varphi\in\mathcal{L}$ is a **context change potential (CCP)** – a function from accessibility relations $R,R',\ldots\in\mathcal{D}_\sigma$ to accessibility relations.

A sentential expression denotes an **update** iff for some w,R, it returns a non-empty subset of $R(w)$ when the result of applying it to R is applied to w. It denotes a **test** iff for all w it returns either $R(w)$ or $\emptyset$ when the result of applying it to R is applied to w.[13]

(DEF.5) Where $[\varphi]\in\mathcal{D}_{\langle\sigma,\sigma\rangle}$:
- $[\varphi]$ is an **update** iff $\exists R,w$: $\emptyset\subset R[\varphi](w)\subset R(w)$.
- $[\varphi]$ is a **test** iff $\forall R,w$: $R[\varphi](w)=R(w) \vee R[\varphi](w)=\emptyset$.

Truth, $\vDash_T$, and consistency, $\vDash_C$**,** are defined relative to world,context-pairs. Where $w,R\vDash_T\varphi$, we say that φ is true-at-$\langle w,R\rangle$. Where $w,R\vDash_C\varphi$, we say that φ is consistent-at-$\langle w,R\rangle$. $\Gamma\vDash_T\varphi$ iff φ is true at $\langle w,R\rangle$ only if every $\psi\in\Gamma$ is true-at-$\langle w,R\rangle$. *Mutatis mutandis* for $\Gamma\vDash_C\varphi$.

(DEF.6) Where $w\in\mathcal{D}_S$ and $R\in\mathcal{D}_\sigma$:
- $w,R\vDash_T\varphi$ iff $[\![\varphi]\!](w)=1$.
- $w,R\vDash_C\varphi$ iff $R[\varphi](w)\neq\emptyset$.

[13] Under the requirement that, for all φ, $[\varphi]$ is eliminative (i.e., $R[\varphi]\subseteq R$), every sentential expression denotes either an update or a test.

- $\Gamma\vDash_T\varphi$ iff $\forall w$,R, $(\forall\psi\in\Gamma\ w,\mathrm{R}\vDash_T\psi)\supset w,\mathrm{R}\vDash_T\varphi$.
- $\Gamma\vDash_C\varphi$ iff $\forall w$,R, $(\forall\psi\in\Gamma w,\mathrm{R}\vDash_C\psi)\supset w,\mathrm{R}\vDash_C\varphi$.

For every $\mathrm{R}\in\mathcal{D}_\sigma$, $\mathcal{C}^\mathrm{R}$ is a function from sentential expressions $\varphi\in\mathcal{L}$ into $\mathcal{D}_{\langle st\rangle}$. $\mathcal{C}^\mathrm{R}(\varphi)$ is the proposition which maps w to 1 iff φ is consistent-at-$\langle w,\mathrm{R}\rangle$.

(DEF.7) Let $\mathcal{C}^\mathrm{R}(\varphi)\in\mathcal{D}_{\langle s,t\rangle}$ be the **communicated content** of φ at R:
- $\mathcal{C}^\mathrm{R}(\varphi)=(\lambda w.\ w,\mathrm{R}\vDash_C\varphi)$

§4 presents a fragment of English in the DLT-framework and shows how it is able to account for the data presented in §1-2.

4. Fragment

4.1. Basic sentences

We assume that the static and dynamic interpretation functions coincide for singular terms, verbs and common nouns in the fragment. Singular terms are treated as denoting individuals (type e), whereas common nouns and verbs denote (intensions of) properties (type $\langle e\langle st\rangle\rangle$) and relations (type $\langle e\langle e\langle st\rangle\rangle\rangle$), respectively.

(I.) a. ⟦The British Library⟧=[The British Library]=THE BRITISH LIBRARY.
b. ⟦book⟧=[book]=$\lambda x\lambda w.$ BOOK$(x)(w)$.
c. ⟦owns⟧=[owns]=$\lambda x\lambda y\lambda w.$ OWN$(y)(x)(w)$.

The static and dynamic interpretation functions diverge in value for numerical determiners. The static denotation assigned to '14 million' will be its standard value as a determiner (type $\langle\langle e\langle st\rangle\rangle\langle e\langle st\rangle\rangle t\rangle$). For simplicity, we will assume the upper-boundedness of bare numerical determiners. In contrast, the dynamic denotation of '14 million' will be a function from a pair of (intensions of) properties to a CCP. Let F,G,… be variables over $\mathcal{D}_{\langle e\langle st\rangle\rangle}$:

(II.) a. ⟦14 million⟧= $\lambda F\lambda G\lambda w.\ |\ \lambda x(F(x)(w))\cap\lambda x(G(x)(w))\ | = 1.4\times10^7$.
b. [14 million]=$\lambda F\lambda G\lambda R\lambda w\lambda w'.\ w'\in R(w)\wedge R(w)\cap(\lambda w.[\![14\text{ mil.}]\!](F)(G)(w))\neq\emptyset$.

The static denotation specified in (II.) maps a pair of properties to the proposition true at a world w iff the cardinality of their intersection at w is 14,000,000. The dynamic denotation specified in (II.) maps a pair of properties to a CCP (a function from accessibility relations to accessibility relations).

Assuming the DP to undergo QR out of direct object position, (1) is assigned the simplified LF in (11), generating the static and dynamic denotations in (12)-(13) respectively:[14]

(11) *[*14 million books *[*λ_1 *[[* the BL*] [*owns t_1*]]]]*.

[14] Slanted brackets, *[ ]*, are used to represent constituent structure in order to avoid confusion with the dynamic interpretation function, [·].

(12) $[\![(11)]\!]=\lambda w.\ |\lambda x.\ (\textsc{Book}(x)(w))\cap\ \lambda x.(\textsc{Own}(\textsc{The BL})(x)(w))|=14{,}000{,}000$.

(13) $[(11)]=\lambda R\lambda w\lambda w'.\ w'\in R(w)\wedge R(w)\cap[\![(11)]\!]\neq\emptyset$.

The static denotation of (11) is the proposition true at *w* iff the number of individuals which are both books at *w* and owned by the British Library at *w* is 14,000,000.

The dynamic denotation of (11) is a test. Given an accessibility relation R it returns the relation R[(11)] such that, for all *w*, R[(11)](*w*)=R(*w*) if there is some R-accessible world from *w* at which $[\![(11)]\!]$ is true; otherwise R[(11)](*w*)=∅. Identifying the felicity of the utterance of φ at a world *w* and context C with the consistency of φ at $\langle w,R^C\rangle$, this correctly predicts the felicity judgements regarding (1) in §1. Where R^C is the relation of pragmatic equivalence at C, an utterance of (11) will be felicitous at *w* and C iff there is some world R^C-accessible from *w* at which the British Library owns 14 million books. Alternatively stated, felicitous utterance of (11) requires that the actual world does not differ from one in which the British Library owns 14 million books in any ways which are pragmatically relevant.

For example, let $C^{\pm}$ be a context in which any difference between the number of books owned by the BL and the number of books owned by the BL when rounded to the nearest million is pragmatically irrelevant.[15] That is, $w'\in R^{C\pm}(w)$ iff $\forall n\in\mathbb{N}$: $10^6(n)-|\lambda x.\ (\textsc{Book}(x)(w'))\cap\lambda x.(\textsc{own}(\textsc{The BL})(x)(w'))|\leq\pm 500{,}000$ iff $10^6(n)-|\lambda x.\ (\textsc{Book}(x)(w))\cap\lambda x.(\textsc{own}(\textsc{The BL})(x)(w))|\leq\pm 500{,}000$. Let w^* be a world at which there are 13,950,000 books owned by the library. Then an utterance of (11) is predicted to be felicitous at w^*, since there exists a world *w*′ $R^{C\pm}$-accessible from *w* such that $[\![(11)]\!](w^*)=1$.[16]

By (Def.7), the communicated content of (11) at $C^{\pm}$ will be strictly weaker than its literal content. For all R, $\mathcal{C}^R((11))(w)=1$ iff there is some world *w*′ R-accessible world from *w* such that $[\![(11)]\!](w')=1$. Thus, an utterance of (11) at $C^{\pm}$ communicates the proposition true at a world *w* iff the number of books owned by the British Library in *w* falls within the interval $[1.35\times10^7,\ 1.45\times10^7]$. Clearly, this proposition is asymmetrically entailed by the literal content of (11).

[15] Assume in addition that the books owned by the British Library is the only thing of pragmatic relevance at $C^{\pm}$.

[16] Note that, for all that has been said, an utterance of (i) at $C^{\pm}$ and *w* is predicted to be equally felicitous:

(i) The British Library owns 14 million and one books.

Furthermore, the conjunction of (1) and (i) is predicted to be felicitous at certain contexts.

In order to accommodate the apparent infelicity of (i) at $C^{\pm}$ and w^* (and the infelicity of its conjunction with (1) at all contexts), we can posit that the choice of numerical determiner in (i) is treated as evidence that the speaker is presupposing a stricter relation of pragmatic equivalence than would be indicated by the utterance of (1). If certain numerical determiners (such as ‘14 million’) are taken to be preferred over others (such as ‘14 million and one’), then the contrast between (i) and (1) can be explained in terms of optimality maximisation (Krifka, 2002, 2007; Klecha, 2014).

4.2. LT-regulators

Let ↓ be a function from (intensions of) properties to CCPs.

(DEF.8) $\downarrow = \lambda F \lambda R \lambda w \lambda w'.\ w' \in R(w) \wedge (\lambda x.F(x)(w)) = (\lambda x.F(x)(w'))$.

For any F such that for some x, $\lambda w.F(x)(w)$ is a non-constant function,[17] ↓F is an **update**. Given an accessibility relation R, it returns that $R' \subseteq R$ such that w' is R′-accessible from w iff w' is R-accessible from w and for all x, $F(x)(w')=1$ iff $F(x)(w)=1$. That is, R(↓F) is the subset of R which relates only worlds which agree regarding the extension of F. For convenience, we adopt postfix notation for ↓F, so that R(↓F) denotes the result of applying ↓F to R.

The LT-regulator 'exactly' is treated as a determiner-modifier. Let Q, Q′… and $\mathcal{Q}$, $\mathcal{Q}'$,… be variables over $D_{\langle\langle e\langle st\rangle\rangle\langle e\langle st\rangle\rangle t\rangle}$ and $D_{\langle\langle e\langle st\rangle\rangle\langle e\langle st\rangle\rangle\langle \sigma,\sigma\rangle\rangle}$ (i.e., the static and dynamic denotations of determiners respectively):

(III.) a. $[\![\text{exactly}]\!] = \lambda Q \lambda F \lambda G \lambda w.\ Q(F)(G)(w)$.
b. $[\text{exactly}] = \lambda \mathcal{Q} \lambda F \lambda G \lambda R \lambda w \lambda w'{:}\ w' \in R(\downarrow G)(w).\ w' \in R(\downarrow G)(\mathcal{Q}(F)(G))(w)$.

The static denotation of 'exactly' is the identity function for functions of type $\langle\langle e\langle st\rangle\rangle\langle e\langle st\rangle\rangle t\rangle$; $[\![\text{exactly } N_{\text{DET}}]\!] = [\![N_{\text{DET}}]\!]$. The dynamic denotation of 'exactly' is a function mapping functions of type $\langle\langle e\langle st\rangle\rangle\langle\langle e\langle st\rangle\rangle\langle\sigma,\sigma\rangle\rangle\rangle$ (that is, the type of the dynamic denotation of determiners) to functions of the same type.

(2a) can be assigned the LF in (14), generating the static and dynamic denotations in (15) and (16), respectively.

(14) *[[[*Exactly 14 million*]* books*] [*λ_1 *[[* the BL*] [*owns t_1*]]]]*.
(15) $[\![(14)]\!] = [\![(11)]\!]$.
(16) $[(14)] = \lambda R \lambda w \lambda w'{:}$
$w' \in R(\downarrow(\lambda x.\lambda w\ \text{OWN}(\text{THE BL})(x)(w)))(w).\ R(\downarrow(\lambda x \lambda w.\ \text{OWN}(\text{THE BL})(x)(w)))\,[(11)]$.

(11) and (14) statically denote the same proposition. However, the CCPs dynamically denoted by (11) and (14) differ. Unlike (11), the dynamic denotation of (14) is divisible into two components: an 'at-issue' update on the input relation R and a 'not-at-issue' domain restriction on the output of this update.

The 'not-at-issue' effect of [(14)] is to make the relation returned by the CCP only partially defined in its second argument place. Given an input R, [(14)] returns a relation R[(14)] such that, for all w, R[(14)](w) is defined on w' iff the set of entities owned by the British Library in w and w' are the same (and $w' \in R(w)$). That is, for all w, the domain of R[(14)](w) is $\{w' \in R(w){:}\ (\lambda x.\text{OWN}(\text{THE BL})(x)(w')) = (\lambda x.\text{OWN}(\text{THE BL})(x)(w'))\}$.

Unlike its counterpart (11) (which constitutes only a test on contexts), update with [(14)] restricts the output relation so that it is only defined on worlds which agree with respect to the

[17] That is, any F such that F does not correspond to an essential property.

extension of the property denoted by the scope of its determiner. By treating the effect of LT-regulators as partially consisting in a domain restriction, this effect is made accessible to higher operators such as negation.

The 'at-issue' update associated with [(14)] can be further sub-divided into two component operations. First, it restricts its input R to that subset which relates w and w' iff the set of entities owned by the BL is the same in w and w'. Intuitively, this can be thought of as a modification of the input context which makes any difference with respect to what the BL owns pragmatically relevant. Second, it applies the test denoted by [(11)] to this relation. Thus, R[(14)](w)=∅ if there is no world w' R-accessible from w at which the things owned by the British Library are the same at w and w' and number of books that it owns at w' is 14 million. Otherwise, R[(14)](w) is that subset of R(w) which agrees with w regarding the things owned by the British Library. Clearly, it follows that (14) will be consistent at $\langle w, \mathrm{R}\rangle$ iff the number of books owned by the BL at w is 14 million.[18]

For example, consider the evaluation of an utterance of (14) at $\mathrm{C}^{\pm}$ and w^*. $\mathrm{R}^{\mathrm{C}\pm}$[(14)]($w^*$) is only defined on that subset of $\mathrm{R}^{\mathrm{C}\pm}(w^*)$ which agrees with w^* on the things owned by the British Library. R[(14)](w^*)=∅ unless that subset contains a world at which the British Library owns 14 million books. Otherwise, R[(14)] relates w^* to the members of the subset of $\mathrm{R}^{\mathrm{C}\pm}(w^*)$ which agrees with w^* on the things owned by the library, and is elsewhere undefined. Yet, since the British Library owns 13,950,000 books at w^*, there is no world which agrees with w^* regarding the things owned by the library at which it owns 14 million books. Hence, (14) is predicted to be infelicitous at $\mathrm{C}^{\pm}$.

By (DEF.7), for any context C, the communicated content of (14) at C will be identical to the literal content of (11), since, for any C, (14) is consistent at $\langle w, \mathrm{R}^{\mathrm{C}}\rangle$ iff ⟦(14)⟧ is true at w. Thus, we correctly predict that (14) can be felicitously uttered only if its literal content is true, and that it communicates the same proposition as it literally expresses.

4.3. Negation

Let the static and dynamic denotations of negation be introduced syncategorematically:

(IV.) a. $[\![\neg\varphi]\!] = \lambda w.\ [\![\varphi]\!](w)=0$.
b. $[\neg\varphi] = \lambda \mathrm{R}\lambda w\lambda w'.\ w'\in\mathrm{R}(w) \wedge \mathrm{R}[\varphi](w)=\emptyset \wedge w'\in\mathrm{D{\small OM}}(\mathrm{R}[\varphi](w))$.

The static denotation of $\neg\varphi$ is simply $\mathcal{D}_s - [\![\varphi]\!]$. The dynamic denotation of $\neg\varphi$, given an input R, returns that relation $\mathrm{R}[\neg\varphi]$ such that, for all w, $w'\in\mathrm{R}[\neg\varphi](w)$ iff conditions (i.)-(iii.) are satisfied:

(i.) $\mathrm{R}[\varphi](w)=\emptyset$;
(ii.) $w'\in\mathrm{R}(w)$;
(iii.) $w'\in\mathrm{D{\small OM}}(\mathrm{R}[\varphi](w))$.

[18] Assuming, at least, that if x is something owned by the BL, then it is pragmatically relevant whether x is a book.

Condition (i.) requires that φ be inconsistent at $\langle w,\mathrm{R}\rangle$. If this condition fails, then $\mathrm{R}[\neg\varphi](w)=\emptyset$. Condition (ii.) requires that w' be R-accessible from w. Accordingly, $\mathrm{R}[\neg\varphi](w)\subseteq\mathrm{R}(w)$. Finally, the failures of commutativity observed in §2.3 suggest that the effects of LT-regulators project out of negation. Thus, condition (iii.) requires that $\mathrm{R}[\varphi](w)$ be defined on w'. Accordingly, $\mathrm{R}[\neg\varphi](w)$ includes only those members of $\mathrm{R}(w)$ which satisfy the domain restrictions (if any) introduced by $[\varphi]$. Combining (i.)-(iii.), if $\mathrm{R}[\varphi](w)=\emptyset$, then $\mathrm{R}[\neg\varphi](w)$ is that subset of $\mathrm{R}(w)$ in the domain of $\mathrm{R}[\varphi](w)$; otherwise $\mathrm{R}[\neg\varphi](w)=\emptyset$.

Since $[\![(11)]\!]=[\![(14)]\!]$, the static denotations of their negations of are identical. However, the dynamic denotations of $\neg(11)$ and $\neg(14)$ differ substantially. To see why, consider the difference in the effect of their utterance at $\mathrm{C}^{\pm}$ and w.

Suppose, first, that $\neg(11)$ is uttered. By condition (i.), $\mathrm{R}^{\mathrm{C}\pm}[\neg(11)](w^*)=\emptyset$ if $\mathrm{R}^{\mathrm{C}\pm}[(11)](w^*)\neq\emptyset$. Yet, as noted in §4.1, if the BL owns 13,950,000 books in w^*, then there is a world w' $\mathrm{R}^{\mathrm{C}\pm}$-accessible from w^* at which it owns 14 million. Hence, $\emptyset\subset\mathrm{R}^{\mathrm{C}\pm}[(11)](w^*)=\mathrm{R}^{\mathrm{C}\pm}(w^*)$, and, accordingly, $\mathrm{R}^{\mathrm{C}\pm}[\neg(11)](w^*)=\emptyset$.

In contrast, suppose $\neg(14)$ is uttered. Since, as noted in §4.2, $\mathrm{R}^{\mathrm{C}\pm}[(14)](w^*)=\emptyset$, condition (i.) is satisfied. Thus, $\mathrm{R}^{\mathrm{C}\pm}[\neg(14)](w^*)$ is that subset of $\mathrm{R}^{\mathrm{C}\pm}(w^*)$ on which $\mathrm{R}^{\mathrm{C}\pm}[(14)](w^*)$ is defined. $\mathrm{R}^{\mathrm{C}\pm}[(14)](w^*)$ is defined on w' iff $w'\in\mathrm{R}(w^*)$ and agrees with w^* regarding the things owned by the BL. Thus, $\mathrm{R}^{\mathrm{C}\pm}[\neg(14)](w^*)$ is that subset of $\mathrm{R}(w^*)$ which agrees with w^* regarding the things owned by the BL. Thus, for all $w'\in\mathrm{R}^{\mathrm{C}\pm}[\neg(14)](w^*)$, the BL owns 13,950,000 books in w'.

By (DEF.7), the communicated content of $\neg(11)$ will be strictly stronger than its literal content. For all w, there is some world $\mathrm{R}^{\mathrm{C}\pm}$-accessible from w at which the BL owns 14 million books iff the number of books the library owns at w is within the interval $[13.5\times10^6,14.5\times10^6]$. Thus, an utterance of $\neg(11)$ at $\mathrm{C}^{\pm}$ communicates the proposition that the number of books the library owns falls outside this interval. Clearly, this proposition asymmetrically entails the literal content of $\neg(11)$.

4.4. Conjunction and failures of commutativity

Let the dynamic denotation of conjunction be introduced syncategorematically:

(V.) a. $[\![\varphi\wedge\psi]\!]=\lambda w.\ [\![\varphi]\!](w)=[\![\psi]\!](w)=1$.
b. $[\varphi\wedge\psi]=\lambda\mathrm{R}.\ \mathrm{R}[\varphi][\psi]$.

The static denotation of $\varphi\wedge\psi$ is the intersection of $[\![\varphi]\!]$ and $[\![\psi]\!]$. The dynamic denotation of $\varphi\wedge\psi$, given a relation R, returns the result of sequentially updating R with $[\varphi]$ and $[\psi]$. Say that conjunction is statically commutative iff $\varphi\wedge\psi\vDash_{\mathrm{T}}\psi\wedge\varphi$; say that conjunction is dynamically commutative iff $\varphi\wedge\psi\vDash_{\mathrm{C}}\psi\wedge\varphi$. Under (V.), $\wedge$ is statically but not dynamically commutative. In particular, $(11)\wedge\neg(14)\nvDash_{\mathrm{C}}\neg(14)\wedge(11)$. To see why, consider the difference in the effect of the utterance of $(11)\wedge\neg(14)$ and $\neg(14)\wedge(11)$ at $\mathrm{C}^{\pm}$ and w^*.

Suppose, first, that (11)∧¬(14) is uttered. As noted in §4.1, there is a world $R^{C\pm}$-accessible from w^* at which the BL owns 14 million books. Thus, $R^{C\pm}[(11)](w^*)=R^{C\pm}(w^*)$. As such, $R^{C\pm}[(11)\wedge\neg(14)](w^*)=R^{C\pm}[\neg(14)](w^*)$. Yet as noted in §4.3, since (14) is inconsistent at $\langle w^*, R^{C\pm}\rangle$, $R^{C\pm}[\neg(14)](w^*)$ is that subset of $R^{C\pm}(w^*)$ which agrees with w^* on the things owned by the BL. Thus, since w^* is itself one such world, $R^{C\pm}[\neg(14)](w^*)\neq\emptyset$. Utterances of (11)∧¬(14) are correctly predicted to be felicitous at $C^{\pm}$ and w^*.

In contrast, suppose that ¬(14)∧(11) is uttered. As noted, $R^{C\pm}[\neg(14)](w^*)$ is that subset of $R^{C\pm}(w^*)$ which agrees with w^* on the things owned by the BL. Thus, for any w' which is $R^{C\pm}[\neg(14)]$-accessible from w^*, the BL owns 13,950,000 books in w'. Yet, from §4.1, for any R, $R[(11)](w^*)=\emptyset$ unless there is some world R-accessible from w^* at which the library owns 14 million books. Thus, $R^{C\pm}[\neg(14)][(11)](w^*)=\emptyset$. Utterances of ¬(14)∧(11) are correctly predicted to be infelicitous at $C^{\pm}$ and w^*.

More generally, (11)∧¬(14) is predicted to be consistent at any $\langle w,R\rangle$ such that $w,R\vDash_C(11)$ but $w,R\nvDash_T(11)$; that is, at which (11) is false but felicitously assertable. In contrast, ¬(14)∧(11) is predicted to be inconsistent at all $\langle w,R\rangle$. As such, we correctly predict the contrast observed between (9a) and (9b).

5. Conclusion

Loose utterances display two central features which have gone widely unobserved: First, the communicated content of certain loose utterances of negated sentences is strictly stronger than the utterance's literal content. Second, the felicity of the loose utterance of certain conjunctions fails to commute. Under the present proposal, these features have been proposed to be related, and to arise from the interaction of negation, conjunction and LT-regulators in cases of loose talk.

More generally, it has been argued that in order to account for these phenomena it is important to recognize that loose utterances are not merely *dependent* upon contexts for their felicity, but also serve to *change* the context in systematic ways. Due to the effect of LT-regulators two sentences, such as (1) and (2b), which agree in their truth conditions may have different effects on context. To accommodate the role of LT-regulators, the effect of an utterance on a context must be taken to be determined by components of its meaning which outstrip its truth conditions. The fragment presented in §4 offers one way of implementing this observation.

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Implicatures of modified numerals: quality or quantity?[1]

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Abstract. This paper presents a theory of modified numerals that derives a three-way distinction in the implicature profile between superlative modifiers, comparative modifiers, and bare numerals. In contrast to the recent proposal by Schwarz (2016a), and drawing on elements from Coppock and Brochhagen's (2013) inquisitive analysis, the proposal decouples ignorance implicatures from upper-bounding implicatures, and thereby captures an important difference between *more than* and *at least*, which differ in their ignorance implicatures but both lack an upper-bounding implicature. At the same time, it accounts for the context-sensitivity in the ignorance implicatures of modified numerals found by Westera and Brasoveanu (2014), and addresses a problem with Coppock and Brochhagen (2013) pointed out by Schwarz (2016b). The key feature of the proposal is the fact that ignorance implicatures may arise in two different ways, namely, both from the Maxim of Quantity and from the Maxim of Quality.

Keywords: modified numerals, ignorance implicatures, inquisitive semantics.

1. Introduction

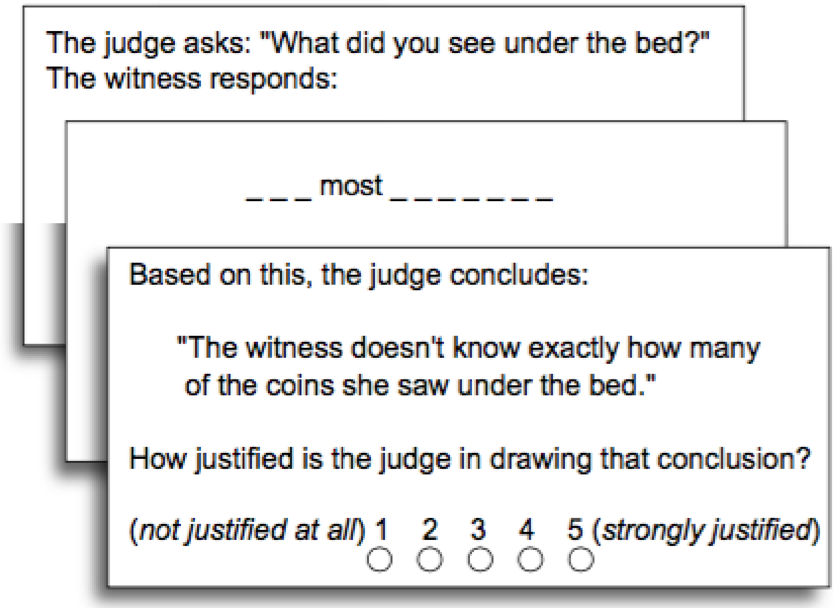
1.1. Empirical targets

We will be concerned with three types of modified numerals: *at least n*, *more than n*, and *n or more*. Many authors have observed that these contrast with each other, as well as with bare numerals, in the implicatures that they give rise to. The basic empirical picture, which is assumed in most work on the topic, is as follows (where the ignorance implicature of *at least six* and *six or more* is not just that the speaker does not know exactly how many sides a hexagon has, but also that she considers it possible that it has precisely six sides).

(1)	a.	A hexagon has six sides.	$\rightsquigarrow$ exactly six	$\not\rightsquigarrow$ ignorance
	b.	A hexagon has more than five sides.	$\not\rightsquigarrow$ exactly six	$\not\rightsquigarrow$ ignorance
	c.	A hexagon has at least six sides.	$\not\rightsquigarrow$ exactly six	$\rightsquigarrow$ ignorance
	d.	A hexagon has six or more sides.	$\not\rightsquigarrow$ exactly six	$\rightsquigarrow$ ignorance

Westera and Brasoveanu (2014) argue based on experimental data that this basic empirical picture is actually a bit too simplistic. They presented experimental participants with a courtroom dialogue, in which a judge asks the witness a question (e.g. *What did you see under the bed?*) and the witness responds with a sentence containing a modified numeral, e.g. *I saw at most 10*

[1]We would like to thank the audience at Sinn und Bedeutung 21 in Edinburgh, as well as Stavroula Alexandropoulou, Dominique Blok, Alexandre Cremers, Jakub Dotlačil, Sven Lauer, Yaron McNabb, Rick Nouwen, Paul Portner, and Matthijs Westera for valuable feedback and discussion. Finally, we gratefully acknowledge financial support from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (Starting Grant, agreement number 680220), and from the Riksbankens Jubileumsfond (Pro Futura Scientia scholarship).



POLAR Did you find {at most / less than} ten of the diamonds under the bed?
WHAT What did you find under the bed?
HOWMANY How many of the diamonds did you find under the bed?

APPROX Approximately how many of the diamonds did you find under the bed?
EXACT Exactly how many of the diamonds did you find under the bed?
DISJUNCT Did you find eight, nine, ten, or eleven of the diamonds under the bed?

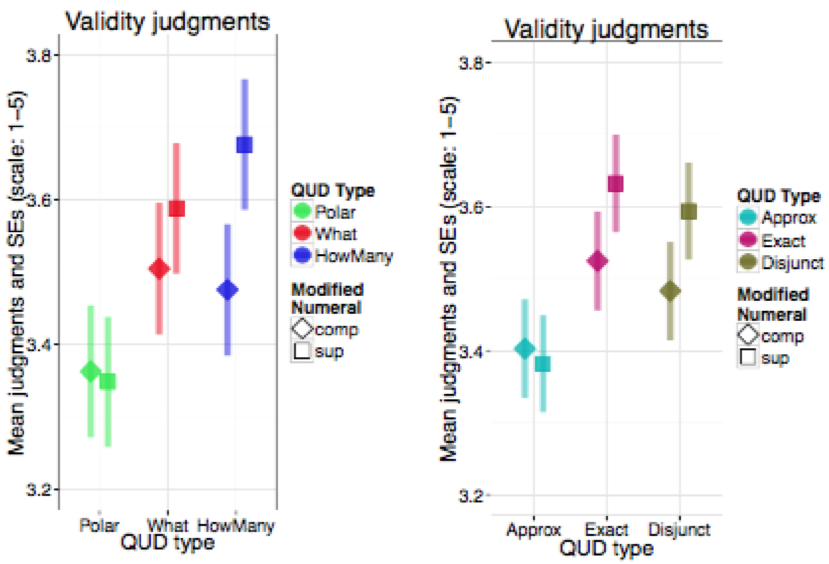


Figure 1: Westera and Brasoveanu's (2014) design and results.

diamonds under the bed. The type of question was experimentally manipulated as indicated in Figure 1 below, and the witness's response always contained either *at most 10* or *less than 10*. The participant is then told that the judge concludes that the witness does not know exactly how many of the relevant kind of items she saw under the bed (the *ignorance inference*), and asked how justified the judge is in drawing that conclusion, on a 1-5 scale.

Their results (see Figure 1) show that comparative modifiers can signal ignorance (e.g. in response to 'how many' questions), and that ignorance can disappear for superlative modifiers (in response to certain polar questions). Note, however, that in most contexts, in particular in response to 'how many' questions, superlative modifiers do give rise to stronger ignorance implicatures than comparative modifiers, in line with what had been assumed in the literature. Another point to notice is that W&B's 'polar question' context involves an echo response.

(2) A: Did you find at most 10 of the diamonds under the bed?
B: I found at most 10 of the diamonds under the bed.

This may be essential for the ignorance implicature not to arise. Compare:

(3) A: Did Johnny eat at least four apples today?
B: Yes, he ate at least four apples. $\not\rightsquigarrow$ ignorance

(4) A: Did Johnny eat more than three apples today?
B: Yes, he ate at least four apples. $\rightsquigarrow$ ignorance

If we compare *more than* and *at least* in non-echo responses to a polar question, the latter seems to implicate ignorance but the former doesn't:

(5) *Context: Johnny's diet prescribes that he eat at most three apples per day.*
A: Did Johnny stick to his diet today?
B: No, he ate more than three apples. $\not\rightsquigarrow$ ignorance
B′: No, he ate at least four apples. $\rightsquigarrow$ ignorance

Moreover, 'out of context', *at least* signals ignorance as well, unlike *more than*:

(6) a. I grew up with more than two parents.
b. ??I grew up with at least three parents.

Finally, ignorance implicatures triggered by *at least*, unlike implicatures triggered by *more than*, do not seem to be cancelable.

(7) a. He has more than 10 cars. In fact, he has 12.
b. He has at least 10 cars. #In fact, he has 12.

So, while we concede that *more than* can trigger an ignorance implicature in response to a 'how many' question, and that the ignorance implicature for *at least* can disappear in the context of certain polar question-answer scenarios (of the echo variety), it seems that the ignorance implicature triggered by *at least* arises more widely than the one triggered by *more than*, and it is of a more obligatory and more robust nature.[2] What is the source of this difference?

1.2. Quality or quantity?

At least two approaches have been explored in the literature to explain the ignorance implicatures for superlative modifiers. One approach (e.g., Mayr, 2013b; Kennedy, 2015; Schwarz, 2016a) is to derive ignorance from a particular way of computing **quantity** implicatures. Differences between the various kinds of bare/modified numerals are accounted for on this approach by assuming that they activate different pragmatic alternatives.

Another approach (Coppock and Brochhagen, 2013) is to derive ignorance as a **quality** implicature. The standard Gricean quality maxim, however, does not suffice for this purpose. Rather, Coppock and Brochhagen invoke a quality maxim that is not only concerned with the *informative* content of the uttered sentence, but also with its *inquisitive* content, i.e., the semantic alternatives that it introduces. Differences between the various kinds of bare/modified numerals are accounted for on this approach by assuming that they introduce different semantic alternatives.

Note that in other empirical domains (e.g., free choice effects of disjunction under modals or in the antecedent of a conditional), these two approaches have also both been pursued. We will suggest that, in the domain of modified numerals, a **combination** of the two approaches is in fact needed. We will develop such a combined account, and show that it improves on earlier proposals which placed the entire explanatory burden either on quantity or on quality.

2. Previous approaches

2.1. Quantity-based

We will first review a specific quantity-based account of ignorance implicatures, reformulating it in a way that will allow for easy comparison with our own approach. We focus on the proposal of Schwarz (2016a), but see Mayr (2013a) and Kennedy (2015) for closely related proposals.

Schwarz is concerned with *at least n* (not with *more than n* or with *n or more*). He assumes that ⟨ *at least*, *only* ⟩ forms a Horn scale, along with ⟨ 1, 2, 3, ... ⟩. This yields the following set of pragmatic alternatives for *Al hired at least two cooks*:

[2] Shortly before the deadline for submitting the present paper, we became aware of the work of Mayr and Meyer (2014), who make very similar empirical observations, and offer an alternative account of the crucial datapoints. Detailed comparison with the present approach must be left for a future occasion.

[1]	only 1	[1	2	3	4	...	)	at least 1
[2]	only 2		[2	3	4	...	)	at least 2
[3]	only 3			[3	4	...	)	at least 3
[3]	only 4				[4	...	)	at least 4
...	...					...		...

The meanings are visually represented in a way that brings out the fact that none of them are *innocently excludable*, as we will explain below.

To articulate the pragmatics, we introduce the following background notions and notation:

- A speaker's **information state** is a non-empty set of worlds.
- A state s **supports** a sentence φ iff $s \subseteq [\![\varphi]\!]$.
- A state s **rejects** a sentence φ iff $s \cap [\![\varphi]\!] = \emptyset$.
- We use A_φ to denote the set of **lexically determined pragmatic alternatives** for φ.

Implicatures can be seen as imposing constraints on what the speaker's information state might be. On Schwarz's approach, they are derived using the following recipe, based on Innocent Exclusion. Start with the **quality implicature** that the speaker's state s supports φ:

$$0_\varphi := \{s \mid s \text{ supports } \varphi\}$$

Now derive **primary quantity implicatures**: the speaker's state does not support any alternative $\psi \in A_\varphi$ that is stronger than φ itself. Let $A_\varphi^\subseteq$ be the set of those stronger alternatives:

$$A_\varphi^\subseteq := \{\psi \in A_\varphi \mid [\![\psi]\!] \subset [\![\varphi]\!]\}$$

$$1_\varphi := \{s \in 0_\varphi \mid s \text{ does not support any } \psi \in A_\varphi^\subseteq\}$$

Now derive **secondary quantity implicatures** by identifying all alternatives $\psi \in A_\varphi^\subseteq$ satisfying the following two conditions:

1. ψ is **not known** by the speaker according to 1_φ. That is, no $s \in 1_\varphi$ supports ψ.
2. ψ is **innocently excludable** relative to φ (Gazdar, 1979; Fox, 2007).

In a nutshell, ψ is innocently excludable if, whenever a set of alternatives in $A_\varphi^\subseteq$ has been consistently rejected we can always go on to reject ψ in addition, maintaining consistency. More precisely: for every subset A' of $A_\varphi^\subseteq$, if there are information states that validate the quality implicature and primary quantity implicatures of φ while rejecting every sentence in A', i.e., if:

$$\{s \in 1_\varphi \mid s \text{ rejects every sentence in } A'\} \text{ is } \textbf{non-empty}$$

then there are also information states that validate the quality implicature and primary quantity implicatures of φ while rejecting every sentence in A' *as well as* ψ:

$$\{s \in 1_\varphi \mid s \text{ rejects every sentence in } A' \cup \{\psi\}\} \text{ is } \textbf{non-empty}$$

If $\psi \in A_\varphi^{\subsetneq}$ is not known by the speaker according to 1_φ and innocently excludable relative to φ, then we say that ψ is **eligible for a secondary quantity implicature**.

$$2_\varphi := \{s \in 1_\varphi \mid s \text{ rejects every } \psi \in A_\varphi^{\subsetneq} \text{ eligible for a secondary quantity implicature}\}$$

Uttering a sentence φ against the background of a question Q in information state s is **licensed** only if $s \in 0_\varphi$ (speaker adheres to Quality) and $s \in 1_{\varphi,Q} \cap 2_{\varphi,Q}$ (speaker adheres to Quantity). Since $0_\varphi \subseteq 1_{\varphi,Q} \subseteq 2_{\varphi,Q}$, this amounts to saying that $s \in 2_{\varphi,Q}$.

None of the pragmatic alternatives that Schwarz assumes for *Al hired at least two cooks* (see above) is innocently excludable. For instance, rejecting 'only two' is not consistent with rejecting 'at least three', given the quality assumption that 'at least two'. So we get primary quantity implicatures, but no secondary ones. Hence ignorance is derived, and no 'upper bounding' implicature (exactly n) arises, as desired.

Shortcomings This approach entails a very tight coupling between ignorance implicatures and upper bounding implicatures. A consequence of this is that it is unclear how to distinguish *more than* from *at least*; as mentioned above, both lack upper bounding implicatures, but behave differently with respect to ignorance.

Furthermore, the effects of the QUD documented by Westera and Brasoveanu (2014) are not immediately accounted for (although Schwarz makes it clear that the theory should ultimately be refined, restricting the set of pragmatic alternatives to those that are contextually relevant). We aim to remedy both of these shortcomings in the proposal below.

2.2. Quality-based

The quality-based approach that we will build on (Coppock and Brochhagen, 2013) is formulated in inquisitive semantics (Ciardelli et al., 2013). In this framework, every sentence generates a set of semantic alternatives (where each semantic alternative is a set of possible worlds). If a sentence generates two or more alternatives, it is thought of as expressing an issue as to which of these alternatives holds.

Coppock and Brochhagen propose that the set of alternatives generated by an *at least* sentence consists of all those alternatives that are pragmatically at least as strong as one of the alternatives generated by the prejacent. For example, *At least two apples fell* generates the set of alternatives corresponding to *Two apples fell*, *Three apples fell*, *Four apples fell*, etc. Assuming a one-sided analysis of bare numerals, this amounts to the following:

(8) *At least two apples fell*: $\{$**[2,...)**, **[3,...)**, **[4,...)**, $\dots\}$

On a two-sided analysis, the denotation would be:

(9) *At least two apples fell*: $\{$**[2]**, **[3]**, **[4]**, $\dots\}$

Coppock and Brochhagen further assume, besides the standard Gricean quality maxim, 'Don't claim things you don't believe to be true', an inquisitive quality maxim as well, which can be characterized informally as: 'Don't utter an inquisitive sentence if you already know how to resolve the issue that it expresses' (cf. Groenendijk and Roelofsen, 2009). More technically, if a sentence generates multiple alternatives, then, when restricted to the speaker's state, it should still generate multiple alternatives. This, together with the semantics in (8) or (9), derives ignorance implicatures for *at least* sentences.

Shortcomings C&B capture the fact that *at least* generates ignorance implicatures but no upper bounding implicatures, and the fact that bare numerals exhibit exactly the opposite pattern. The analysis is also QUD-sensitive. However, for *more than* they predict that ignorance implicatures do not arise at all, which is in conflict with Westera and Brasoveanu's (2014) experimental results. Moreover, they do not derive the lack of upper bounding implicatures for *more than*. This is a symptom of a deeper problem, which C&B share with the quantity-based approach: the coupling between ignorance implicatures and the lack of upper bounding implicatures is too tight. This means that it becomes difficult, if not impossible, to capture the differences and similarities between *more than* and *at least*: they behave differently with respect to ignorance, but they both lack upper bounding implicatures.

Even if we focus just on *at least*, the C&B account is not fully satisfactory, because, as pointed out by Schwarz (2016b), the ignorance implicature that is derived for *at least n* is too weak: the approach predicts that a speaker uttering (9) should not know exactly how many apples fell, but not that she should consider it possible that exactly *n* apples fell.

Finally, there is framework issue: C&B formulate their account in 'unrestricted' inquisitive semantics, $\mathsf{Inq_U}$, an extension of the standard, basic inquisitive semantics framework, $\mathsf{Inq_B}$. $\mathsf{Inq_U}$ makes more meanings available than $\mathsf{Inq_B}$ does: the latter does not allow for one alternative to be nested in another—as is the case for instance in (8)—while in $\mathsf{Inq_U}$ there are no restrictions on alternative-sets (hence the label 'unrestricted'). However, this extra richness of $\mathsf{Inq_U}$ comes at a price. First, the resulting notion of meaning is less well-behaved from a logical point of view. In particular, it does not come with a suitable notion of entailment and therefore lacks the usual algebraic operations on meanings, like *meet* and *join* (cf., Roelofsen, 2013; Ciardelli et al., 2016). Second, $\mathsf{Inq_U}$ is arguably also less well-behaved from an empirical point of view: as discussed in detail in Ciardelli and Roelofsen (2016), while $\mathsf{Inq_B}$ straightforwardly facilitates an uniform redundancy-based account of so-called *Hurford effects* across declaratives and interrogatives (building on Katzir and Singh, 2013, among others), $\mathsf{Inq_U}$ seems to render such an account impossible. One question, then, is whether an analysis of modified numerals along the lines of C&B really needs the full expressive power of $\mathsf{Inq_U}$, or whether it could also be formulated in $\mathsf{Inq_B}$.

3. Proposal

We now spell out a hybrid approach, combining insights from the quality- and quantity-based approaches, and overcoming their respective shortcomings. We provide the necessary background notions and notation from $\mathsf{Inq_B}$ in Section 3.1, spell out our lexical assumptions in Section 3.2, and then turn to the pragmatic component of the account in Section 3.3.

3.1. Background notions and notation

In $\mathsf{Inq_B}$, the meaning of a sentence φ, denoted $[\![\varphi]\!]$, is a set of propositions encoding both the information that is conveyed and the issue that is expressed by φ. Namely, φ is taken to convey the information that the actual world is contained in $\mathsf{info}(\varphi) := \bigcup[\![\varphi]\!]$, and to express an issue which is resolved precisely by those propositions that are in $[\![\varphi]\!]$. It is assumed that if a proposition p resolves an issue, then any stronger proposition $q \subseteq p$ resolves that issue as well. Thus, $[\![\varphi]\!]$ is always *downward closed*: if it contains a proposition p it also contains any $q \subseteq p$. Furthermore, it is assumed that the inconsistent proposition, $\emptyset$, resolves any issue. Thus, $[\![\varphi]\!]$ always contains $\emptyset$ and is therefore always non-empty. Taken together, sentence meanings in $\mathsf{Inq_B}$ are defined as non-empty, downward closed sets of propositions.

In some cases the issue expressed by φ is *trivial*, in the sense that it is already resolved by the information provided by φ itself. This occurs precisely if $\mathsf{info}(\varphi) \in [\![\varphi]\!]$. A sentence φ is called **inquisitive** just in case the issue it expresses is non-trivial, i.e., just in case $\mathsf{info}(\varphi) \notin [\![\varphi]\!]$.

Finally, the **alternatives** associated with a sentence φ in $\mathsf{Inq_B}$ are those propositions that contain precisely enough information to resolve the issue expressed by φ. Technically, these are the maximal elements of $[\![\varphi]\!]$:

$$\mathsf{alt}(\varphi) := \{p \in [\![\varphi]\!] \mid \text{there is no } q \in [\![\varphi]\!] \text{ such that } p \subsetneq q\}$$

Note that, as remarked above, this characterization of alternatives entails that one alternative can never be properly contained in another, otherwise it could not be a maximal element of $[\![\varphi]\!]$. Also note that if φ is non-inquisitive, it is always associated with a unique alternative, namely $\mathsf{info}(\varphi)$. Vice versa, if φ generates multiple alternatives, then it must be inquisitive.[3]

[3]We should note here that there are several perspectives one can take on the connection between inquisitiveness, a semantic notion, and the communicative effects of sentences when uttered in discourse. The perspective assumed here, in the spirit of Groenendijk (2009) and Coppock and Brochhagen (2013), is that even if a sentence is inquisitive, i.e., even if it semantically expresses a non-trivial issue, a speaker who utters this sentence in discourse does not necessarily *raise* this issue. In particular, she does not necessarily *request* a response that addresses the issue. Under this perspective, it is possible to assume that a disjunctive declarative like *John ate*

3.2. Lexical assumptions

Following C&B, we assume that *at least* sentences generate multiple alternatives. However, we adopt a suggestion made by Schwarz (2016b) in his critique of C&B and analyze *at least n* as having the same meaning as *n or more* would have in inquisitive semantics.[4] For example:

(10) alt(*At least two apples fell*) = alt(*Two or more apples fell*) = { **[2]**, **[3,...)** }

Notice that, unlike in the C&B analysis, the alternatives for *at least n* are not nested within each other; in fact, they are mutually exclusive. This means that the analysis we are proposing can be formulated in the standard inquisitive semantics framework $\mathsf{Inq_B}$, allowing us to avoid the problems that arise in the unrestricted framework $\mathsf{Inq_U}$.[5]

Following C&B we assume that *more than n* contrasts with *at least n* and with *n or more* in that it is associated with a single semantic alternative:[6]

(11) alt(*More than two apples fell*) = { **[3,...)** }

Turning now to pragmatic alternatives, we assume that the lexically determined pragmatic alternatives for *at least n* are $\{at\ least\ m \mid m \in \mathbb{N}\}$ and $\{m \mid m \in \mathbb{N}\}$, and similarly for *n or more* and for *more than n*:

(12) Lexically determined pragmatic alternatives
 a. *at least n*: $\{at\ least\ m \mid m \in \mathbb{N}\} \cup \{m \mid m \in \mathbb{N}\}$
 b. *n or more*: $\{m\ or\ more \mid m \in \mathbb{N}\} \cup \{m \mid m \in \mathbb{N}\} \cup \{more\ than\ m \mid m \in \mathbb{N}\}$
 c. *more than n*: $\{more\ than\ m \mid m \in \mathbb{N}\} \cup \{m \mid m \in \mathbb{N}\}$

---

two or three apples (with falling intonation) is inquisitive, just like the corresponding interrogative *Did John eat two apples, or three?*. One could say that the former is used to make an *assertion* and the latter to ask a *question*, and that in making an assertion, speakers do not raise the issue that the uttered sentence expresses (perhaps their assertion still 'evokes' the issue, but the effect is weaker than in the case of a question). Another perspective that one could take (see, e.g., Farkas and Roelofsen, 2016) is that the issue expressed by a sentence is always raised when the sentence is uttered in discourse. Under this perspective, it does not make sense to treat a disjunctive declarative as being inquisitive, on a par with the corresponding disjunctive question. This perspective allows for a more economical interface between semantics and discourse pragmatics, but is not directly compatible with the present proposal.

[4] The idea of treating *at least n* on a par with *n or more* goes back to Büring (2008).

[5] The meaning for *at least n* given here should, of course, be obtained from a general analysis of *at least*, one that allows us to analyze *at least* in combination with arguments other than numerals. Building on Solt (2011) and Coppock (2016), we assume that an expression of the form *at least P* is interpreted relative to a context providing (i) a *comparison class*, which is a set Φ of propositions, including the proposition associated with the prejacent P and (ii) a *pragmatic strength ordering*, which is a partial order on Φ, possibly but not necessarily coinciding with entailment. Relative to such a context, *at least P* is associated with two semantic alternatives: one is the exhaustification of the prejacent P with respect to the stronger propositions in Φ; the other is the union of all propositions in Φ which are strictly stronger than P. The meaning that we assume in this paper for *at least n* is obtained from this general account by taking the comparison class to be $\Phi = \{[0],[1],[2],\dots\}$, where the strength ordering corresponds to the usual ordering on natural numbers.

[6] The account of *more than n* given here can be lifted to a general treatment of *more than*, allowing for arguments other than numerals, in a way similar to the one sketched in footnote 5 for *at least*.

In general, we assume that the lexical pragmatic alternatives for an expression φ are obtained either by deleting parts of φ, or by replacing a scalar item in φ with an element of the same scale.[7] This makes our pragmatic assumptions less stipulative that those of Schwarz (2016a), and more in line with general theories of pragmatic alternatives (see, in particular, Katzir, 2007).

Following Kennedy (2015), we assume that numerals are ambiguous between a one-sided and a two-sided reading, and the choice between these readings is determined by which yields a stronger interpretation. A two-sided meaning is stronger in a simple positive context, so that is what the *m* alternatives amount to in such a context.

3.3. Pragmatic assumptions

3.3.1. Quality

Following C&B and earlier work on inquisitive pragmatics (Groenendijk and Roelofsen, 2009), we assume that Quality pertains both to the informative and the inquisitive content of the sentence that is uttered. **Informative sincerity** (Gricean Quality) requires that if a speaker utters a sentence φ, her information state s should support the informative content of φ:[8] $s \subseteq \mathsf{info}(\varphi)$.

On the other hand, **inquisitive sincerity** requires that a speaker should not utter an inquisitive sentence if she already knows how to resolve the issue that the sentence expresses. That is, if φ is inquisitive, then the speaker's information state s should not already resolve the issue expressed by φ:[9] $s \notin [\![\varphi]\!]$. Together:

(13) $s \in \mathsf{sincere}(\varphi)$ iff $s \subseteq \mathsf{info}(\varphi)$ and if φ is inquisitive, then $s \notin [\![\varphi]\!]$

3.3.2. Quantity

Following Schwarz (2016a) and many others, we assume that the maxim of quantity is concerned with alternative expressions that the speaker could have used. However, only expressions that are relevant to the question under discussion should be taken into consideration. Thus, unlike Schwarz, we distinguish **lexical** pragmatic alternatives from **contextual** prag-

[7] Strictly speaking, this means that expressions of the form *m and more* also count as alternatives for *n or more*. However, since such expressions are inconsistent, their presence does not affect the predictions of the theory. Therefore, they are left out of consideration and not listed above.

[8] Of course, this maxim and the ones below are only assumed to be in force in a specific type of conversation, namely one in which the participants exchange information in a fully cooperative way.

[9] The original formulation of the inquisitive sincerity maxim in Groenendijk and Roelofsen (2009) makes reference to the common ground: "If a speaker utters a sentence φ that is inquisitive w.r.t. the common ground, then φ should be inquisitive w.r.t. the speaker's information state as well." For our current purposes this qualification is not necessary. Note also that Coppock & Brochhagen operate with a stronger sincerity maxim, which they call the maxim of *interactive sincerity*. On their account this is needed because the predictions that inquisitive sincerity delivers are too weak. On our present account, inquisitive sincerity delivers the right predictions, and interactive sincerity would do so as well; indeed, interactive sincerity boils down to inquisitive sincerity in InqB.

matic alternatives. The set of lexical pragmatic alternatives for a sentence φ is denoted as A_φ. The set of contextual pragmatic alternatives for φ relative to a question under discussion Q, denoted $A_{\varphi,Q}$, contains only those lexical pragmatic alternatives that are **relevant** to Q:

(14) $A_{\varphi,Q} = \{\psi \in A_\varphi \mid \psi \text{ is relevant to } Q\}$

What does it mean for ψ to be relevant to Q? Recall that the semantic alternatives in $\mathsf{alt}(Q)$ are propositions that contain precisely enough information to resolve the issue expressed by Q. They can be thought of, then, as wholly relevant, complete resolutions of Q. Similarly, any union of two or more such alternatives can be thought of as a wholly relevant, partial resolution of Q. Thus, we say that ψ is relevant to Q if and only if $\mathsf{info}(\psi)$ coincides with the union of a set of semantic alternatives in $\mathsf{alt}(Q)$.

For our current purposes we will stay as close as possible to Schwarz's Innocent Exclusion-based recipe for deriving implicatures. The only serious change is that the standard Gricean Quality requirement is replaced by the requirement that the speaker be both informatively and inquisitively sincere; we also restrict attention to relevant alternatives. So the recipe runs as follows:

The first step, as before, is to compute the **quality implicature**:

$$0_\varphi = \{s \mid s \in \mathsf{sincere}(\varphi)\}$$

Next, also as before, we compute **primary quantity implicatures**, based on the assumption that any pragmatic alternative for φ that would have been more informative was apparently not sincerely utterable, either the speaker's information state doesn't support its informative content, or because the speaker can already resolve the issue that it expresses. We restrict the set of pragmatic alternatives here to those that are relevant, $A_{\varphi,Q}$. Let $A^{\subset}_{\varphi,Q}$ be the set of such alternatives that are stronger than φ itself: $A^{\subset}_{\varphi,Q} = \{\psi \in A_{\varphi,Q} \mid \mathsf{info}(\psi) \subset \mathsf{info}(\varphi)\}$.

$$1_{\varphi,Q} = \{s \in 0_\varphi \mid \text{for all } \psi \in A^{\subset}_{\varphi,Q} : s \notin \mathsf{sincere}(\psi)\}$$

Finally, again as before, we compute **secondary quantity implicatures**. The recipe for doing so is the same as on Schwarz's proposal, except that we now take Q into consideration. That is, we identify all pragmatic alternatives ψ in $A^{\subset}_{\varphi,Q}$ such that:

1. ψ is **not known** by the speaker according to $1_{\varphi,Q}$. That is, no $s \in 1_{\varphi,Q}$ supports $\mathsf{info}(\psi)$.

2. ψ is **innocently excludable** relative to φ and Q.

The second condition is satisfied just in case for every subset A' of $A^{\subset}_{\varphi,Q}$, if there are information states that validate the quality implicature and primary quantity implicatures of φ while rejecting every sentence in A', i.e., if:

$$\{s \in 1_{\varphi,Q} \mid s \text{ rejects every sentence in } A'\} \text{ is } \textbf{non-empty}$$

then there are also information states that validate the quality implicature and primary quantity implicatures of φ while rejecting every sentence in A' *as well as* ψ:

$$\{s \in 1_{\varphi,Q} \mid s \text{ rejects every sentence in } A' \cup \{\psi\}\} \text{ is } \textbf{non-empty}$$

If $\psi \in A^{\subset}_{\varphi,Q}$ is not known by the speaker according to $1_{\varphi,Q}$ and innocently excludable relative to φ and Q, then we say that ψ is **eligible for a secondary quantity implicature**.

$$2_{\varphi,Q} = \{s \in 1_{\varphi,Q} \mid s \text{ rejects any } \psi \in A^{\subset}_{\varphi,Q} \text{ eligible for a secondary quantity implicature}\}$$

As before, uttering a sentence φ against the background of a question Q in information state s is **licensed** only if $s \in 2_{\varphi,Q}$, that is, only if the speaker adheres to Quality and Quantity.

4. Predictions

We now discuss the predictions that our account makes for sentences involving bare or modified numerals.

4.1. Predictions in the context of a *how many* question

Suppose the question under discussion is (15a), which we take to be associated with the set of alternatives in (15b).

(15) a. How many apples did John eat?
b. $Q = \{[0],[1],[2],[3],[4],[5],\ldots\}$

Bare numerals First let us consider our predictions for the sentence (16a), involving the bare numeral *three*. Again, following Kennedy (2015), we assume that numerals are scopally ambiguous between a one-sided interpretation (e.g. $[3,\ldots)$) and a two-sided one (e.g. $[3]$), and that the interpretation that yields the strongest meaning is the one that is chosen. This means that the basic interpretation of the bare numeral example in (16a) is an 'exactly' reading:

(16) a. φ: John ate three apples.
b. $\mathsf{alt}(\varphi) = \{[3]\}$

Since this sentence is not inquisitive, quality simply requires the speaker to believe that the number of apples that John ate is indeed three.

(17) $0_\varphi = \mathsf{sincere}(\varphi) = \{s \mid s \subseteq [3]\}$

It is easy to see that, given this strong quality implicature, quantity implicatures cannot lead to any stronger conclusion about the speaker's state. Thus, for (16a) we predict an exact interpretation, and no ignorance implicature.

Superlative modifiers Next, let us consider the sentence (18a), involving the superlative modifier *at least*. The semantic alternatives for this sentence in our account are given in (18b).

(18) a. φ : John ate at least three apples.
b. $\mathsf{alt}(\varphi) = \{[3], [4, \dots)\}$

Consider the quality implicatures that are drawn about the state s of the speaker. As before, sincerity requires that $s \subseteq \mathsf{info}(\varphi)$, that is, $s \subseteq [3, \dots)$. However, since φ is inquisitive, now sincerity also requires $s \notin [\![\varphi]\!]$; that is, it requires s not to be included in either of the alternatives for φ; in other words, the speaker should not believe that the number of apples was exactly three, nor should she believe that the number is larger than three. Formally, we have:

(19) $0_\varphi = \mathsf{sincere}(\varphi)$
$= \{s \mid s \subseteq [3, \dots) \text{ and } s \not\subseteq [3] \text{ and } s \not\subseteq [4, \dots)\}$

So, from quality considerations we already infer not only that the speaker believes that the number of apples John ate is at least 3, but also that she considers it possible that this number is exactly 3, and that she considers it possible that it is larger than 3.

Next, consider quantity implicatures. We have assumed that the lexical pragmatic alternatives for φ are sentences of the form ψ_n = *John ate at least n apples* or of the form χ_n = *John ate n apples*, for $n \in \mathbb{N}$. All of these sentences are relevant for the question Q, and therefore they qualify as contextual pragmatic alternatives. Thus, $A^{\subset}_{\varphi,Q}$ consists of the sentences ψ_n with $n > 3$, as well as χ_n with $n \geq 3$. Primary quantity implicatures require that none of these sentences could be sincerely uttered by the speaker. However, this is already guaranteed by quality. For take any state $s \in 0_\varphi$. Since $s \not\subseteq [4, \dots)$, whenever $n > 3$ we have that $s \notin \mathsf{sincere}(\psi_n)$ and $s \notin \mathsf{sincere}(\chi_n)$, because informative sincerity fails for these sentences. Moreover, since $s \not\subseteq [3]$, we also have $s \notin \mathsf{sincere}(\chi_3)$. What this shows is that $1_{\varphi,Q} = 0_\varphi$, which means that nothing new is concluded by drawing primary quantity implicatures.

Finally, we will show that no contextual alternative in $A^{\subset}_{\varphi,Q}$ is eligible for a secondary quantity implicature. Consider for example the 'at least' sentence ψ_5, *John ate at least* 5 *apples*. This alternative is not innocently excludable. To see this, consider the set $A' = \{\chi_4\}$, where χ_4 = *John ate 4 apples*, which receives an two-sided ('exactly') interpretation in this context because the two-sided interpretation is stronger than the one-sided one. Rejecting χ_4 is consistent with the primary quantity implicatures; some information states in $1_{\varphi,Q}$ reject it (as a witness, take the state $[3] \cup [5]$). But, given the primary and secondary implicatures, rejecting χ_4 is not consistent with rejecting our candidate alternative ψ_5 (*John ate at least* 5 *apples*); no information state in $1_{\varphi,Q}$ rejects both. In a nutshell, since rejecting ψ_5 forces acceptance of χ_4, the former is not innocently excludable. Similar reasoning holds for all of the other 'at least' formulas ψ_n with $n > 3$.[10] Similarly, to show that each bare numeral alternative χ_n is not innocently excludable we can take $A'_n = \emptyset$ if $n = 3$, and $A'_n = \{\chi_m \,|\, m \geq 4, m \neq n\}$ if $n > 3$.

This shows that no element of $A^{\subseteq}_{\varphi,Q}$ is eligible for a secondary quantity implicature, which means that $2_{\varphi,Q} = 1_{\varphi,Q}$. This means that no secondary quantity implicatures are derived, or more precisely, nothing new is concluded about the state of the speaker by drawing secondary quantity implicatures.

In conclusion, we have $2_{\varphi,Q} = 0_\varphi = \{s \mid s \subseteq [3,...) \text{ and } s \not\subseteq [3] \text{ and } s \not\subseteq [4,...)\}$. Thus, we predict that, from an utterance of (18a) in the context of question (15a), an ignorance implicature is drawn, and no upper bounding implicature. Importantly, the relevant ignorance implicature is not just that the speaker does not know exactly how many apples John ate, but also that the speaker does not know whether John eat exactly three apples or more.

***n* or more** Disjunctions of the form *n or more* are predicted to behave in a parallel fashion to *at least n*. They have the same denotation:

(20) a. φ: John ate three or more apples.
b. $\mathsf{alt}(\varphi) = \{[3], [4,...)\}$

The lexical alternatives are sentences of the form *m*, *m or more*, and *more than m* for all natural numbers *m*. All of these will be relevant in the context of a 'how many' question, and none of them will be innocently excludable for reasons parallel to the ones just given for *at least*. Thus, once again we will predict a strong ignorance implicature, and no upper bounding implicatures.

Comparative modifiers Finally, consider (21a). We have assumed that this sentence has a unique semantic alternative, given in (21b).

(21) a. φ : John ate more than two apples.
b. $\mathsf{alt}(\varphi) = \{[3,\dots)\}$

Let us compute what implicatures are predicted for φ in the context of Q. First consider quality implicatures: since φ is not inquisitive, only the condition $s \subseteq \mathsf{info}(\varphi)$ is relevant to sincerity. Therefore, we have:

(22) $0_\varphi = \mathsf{sincere}(\varphi) = \{s \mid s \subseteq [3,\dots)\}$

So, from quality we infer that the speaker believes that John ate at least three apples.

Now let us turn to quantity implicatures. The set of lexical pragmatic alternatives to φ consists

[10]To see this, consider the set $A'_n = \{\chi_4,\dots,\chi_{n-1}\}$ (in particular, take $A'_4 = \emptyset$). Some information states in $1_{\varphi,Q}$ reject all elements of A'_n: if $n = 4$, this holds trivially, as $A'_4 = \emptyset$; if $n > 4$, we can take as a witness the state $[3] \cup [n]$. However, no information state in $1_{\varphi,Q}$ rejects all elements of A'_n in addition to ψ_n.

of all sentences of the form ψ_n = *John ate more than n apples* or χ_n = *John ate n apples* for n a natural number. All of these pragmatic alternatives are relevant to the question Q we are considering, and therefore qualify as contextual pragmatic alternatives. Therefore, $A_{\varphi,Q} = \{\psi_n \,|\, n \in \mathbb{N}\} \cup \{\chi_n \,|\, n \in \mathbb{N}\}$ and $A^{\subset}_{\varphi,Q} = \{\psi_n \,|\, n \geq 3\} \cup \{\chi_n \,|\, n \geq 3\}$. Just like φ, all pragmatic alternatives ψ_n are non-inquisitive, nor are the pragmatic alternatives χ_n, which means that the sincerity condition boils down to $s \subseteq \mathsf{info}(\psi_n)$ and $s \subseteq \mathsf{info}(\chi_n)$. Therefore, we have the following primary quantity implicatures:

(23) $$\begin{aligned} 1_{\varphi,Q} &= \{s \in 0_\varphi \mid s \notin \mathsf{sincere}(\psi_n) \text{ for } n \geq 3\} \cap \{s \in 0_\varphi \mid s \notin \mathsf{sincere}(\chi_n) \text{ for } n \geq 3\} \\ &= \{s \subseteq [3,\dots) \mid s \not\subseteq [n,\dots) \text{ for } n > 3\} \cap \{s \subseteq [3,\dots) \mid s \not\subseteq [n] \text{ for } n \geq 3\} \\ &= \{s \mid s \subseteq [3,\dots) \text{ and } s \not\subseteq [3] \text{ and } s \not\subseteq [4,\dots)\} \end{aligned}$$

Thus, from the primary quantity implicatures we infer that the speaker does not know the exact number of apples that John ate and, in fact, that she does not know whether John ate exactly three apples or more.

Finally, consider secondary quantity implicatures. Clearly, each pragmatic alternative $\psi \in A^{\subset}_{\varphi,Q}$ is not known by the speaker according to $1_{\varphi,Q}$. But none of these alternatives is innocently excludable, for reasons parallel to those given for *at least* above. Thus, we have $2_{\varphi,Q} = 1_{\varphi,Q}$, that is, nothing new is inferred in drawing secondary quantity implicatures.

Summing up, for (21a) in the context of the 'how many' question (15a) we predict an ignorance implicature and no upper bounding implicature. While the relevant ignorance inference is exactly the same that was derived above for (18a), there is a crucial difference between the two cases: the inference is derived as a *quantity* implicature for (21a), but as a *quality* implicature for (18a). Quality implicatures are viewed as being of a more fundamental nature than other kinds of implicatures.[11] Moreover, they are difficult to cancel (as exhibited by the oddness of Moore sentences) and there is no reason to imagine that they would depend on the question under discussion any more than the content of the utterance does. We take this to account for our observations in Section 1.1, which show that in the case of *at least*, ignorance implicatures arise more robustly and more widely, and are harder to cancel, than in the case of *more than*.[12,13]

4.2. Predictions in the context of a polar question

Let us now consider a context in which not all of the lexical pragmatic alternatives to our sentences are relevant, and therefore available in the computation of quantity implicatures.

[11]For instance, Grice (1975: p.27) writes: "It is obvious that the observance of some of these maxims is a matter of less urgency than is the observance of others; a man who has expressed himself with undue prolixity would, in general, be open to milder comment than would a man who has said something he believes to be false".

[12]Lauer (2014) argues that the ignorance implicatures generated by disjunctions are also of a mandatory nature.

[13]Interestingly, note that in the case of (18a), even if an addressee does not derive the inference as a quality implicature (i.e., if she takes it for granted that the speaker adheres to informative sincerity, but not necessarily to inquisitive sincerity as well), then she would *still* derive ignorance as a quantity implicature, in a way parallel to what we discussed for (21a). This, we suggest, lends additional robustness to the ignorance implicature of *at least* in comparison to that of *more than*.

Suppose that John's diet prescribes that he eat at most two apples per day, and does not prescribe anything else. Consider the polar question in (24a). Given our contextual assumptions, the alternatives for this question are the ones displayed in (24b).

(24) a. Did John stick to his diet today?
b. $Q = \{[0,2],[3,\dots)\}$

Compare the following responses to (24a):

(25) a. No, he ate more than two apples.
b. No, he ate at least three apples.

Intuitively, upon hearing the response (25a) we do not conclude that the speaker is ignorant as to the number of apples that John ate, whereas we do so upon hearing (25b). In other words, the ignorance implicature associated with (25b) still arises in this context, but the implicature stemming from (25a) does not.

This is indeed predicted on our account. To see why, first consider (25b): we have seen above that for this sentence, the ignorance inference arises as a quality implicature; since quality implicatures are context-independent on our account, this implicature is still predicted in the present setting.The same holds for *n or more*.

The situation is different for (25a). For this sentence, an ignorance inference in the context of question (15a) was derived as a quantity implicature. However, on our account the computation of quantity implicatures is sensitive to the question Q under discussion: only lexical pragmatic alternatives which are relevant to Q are taken into account. In the present context, no lexical alternative to φ—except for the sentence φ itself—is relevant to Q. Thus, $A^{\subset}_{\varphi,Q} = \emptyset$, which means that no primary or secondary quantity implicatures are derived. Thus, we predict that the ignorance implicature that we found above for (25a) disappears in the context of the polar question (24a).[14]

5. Conclusion

The proposal we have made here allows us to overcome the shortcomings of previous accounts. It achieves a three-way contrast between superlative modifiers, comparative modifiers, and numerals, in contrast to Schwarz (2016a). It furthermore accounts for the QUD-sensitivity observed by Westera and Brasoveanu (in contrast to both Schwarz and C&B). It predicts ignorance with respect to the prejacent of *at least* (overcoming Schwarz's critique of C&B). And it brings C&B's approach in line with recent theorizing on inquisitive semantics, where one alternative can never entail another.

Most importantly, we account for the following facts: *more than* indeed can imply ignorance in *how many* contexts, as observed by Westera & Brasoveanu, but the ignorance implicature

[14] In addition, notice that, due to the absence of contextually relevant alternatives, we still correctly predict the lack of upper bounding implicatures for both (25a) and (25b).

of *at least* is more robust, as witnessed by (i) the fact that it is perceived to be stronger than the ignorance implicature of *more than* in *how many* contexts; (ii) the fact that it persists in non-echoic responses to polar questions; and (iii) the fact that it contrasts with *more than* 'out of context', as in the following example, repeated from the introduction:

(26) a. I grew up with more than two parents.
b. ??I grew up with at least two parents.

To obtain these results, it is crucial to be able to derive ignorance implicatures through two distinct routes: quality for *at least*, and quantity for *more than*.

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Discourse-structuring conditionals and past tense[1]

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Abstract. In this paper I present some data that challenges the view that a unified semantics of biscuit conditionals and hypothetical conditionals is possible. There is a class of biscuit conditionals that cannot occur with past temporal reference. In these cases, the antecedent serves to structure the discourse and as such must be true of the discourse situation. I argue that this is the reason why the past tense is incompatible with these conditionals, and therefore we can nevertheless maintain a unified semantics for hypothetical and biscuit conditionals.

Keywords: biscuit conditionals, conditionals, (past) tense, discourse structure.

1. Introduction

The literature on conditionals generally distinguishes between *hypothetical conditionals* as in (1) and *biscuit conditionals* as in (2).

(1) If Alex went shopping this morning, there are biscuits on the sideboard.

(2) If you are hungry, there are biscuits on the sideboard.

The default interpretation of (1) includes the notion that the speaker is not committed with respect to whether the consequent *there are biscuits on the sideboard* holds in the actual world w_0. We typically assume that conditionals reason about what could be the case, for example if Alex went shopping in the morning. By contrast, it is generally understood that the speaker of (2) is in fact committed to it being true in w_0 that there are biscuits on the sideboard. So it is intuitively clear why we consider (1) as a conditional: the speaker doesn't know whether the antecedent holds, but she is willing to commit to the consequent holding just in case the antecedent does. The status of (2) is less clear since the speaker is taken to be committed to the truth of the consequent whether the antecedent holds or not. Still, in recent years a number of authors have proposed analyses which allow for a uniform semantics of sentences like (1) and (2), such as Franke (2009), Francez (2015) and Csipak (2015). There are two main arguments for why we may want a unified analysis: the form of both (1) and (2) is *if p, q*, and moreover, we observe that cross-linguistically many languages use the same form to express both meanings. This suggests that this is not simply a coincidence of the English language, but a systematic extension of the form from hypothetical conditionals to biscuit conditionals.

The literature on biscuit conditionals typically discusses examples that are similar in spirit to (2) and its ancestor *There are biscuits on the sideboard if you want them* (discussed first in Austin 1956). This paper is concerned with another type of example that sometimes gets mentioned in connection with biscuit conditionals, but is not treated in more detail. This type of conditional

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is exemplified in (3).

(3) If I may be frank, you look awful.

This paper will be dedicated to identifying the ways in which conditionals like (3) differ from biscuit conditionals such as (2), and whether it is possible to come up with a unified analysis that captures the properties of both.

The rest of the paper is structured as follows. In section 2, I discuss the relevant data. Section 3 discusses why we cannot extend the existing analyses to account for the data in 2. Section 4 contains my analysis. Section 5 takes a brief detour into the realm of counterfactuals, and sketches how the data presented here also present a challenge to theories of counterfactuals. Section 6 concludes.

2. The empirical picture

A first glance at sentences like (3) suggests that they share two properties with biscuit conditionals: they have the form *if p, q*, and the speaker uttering them is taken to be committed to the truth of *q*. We will take this seriously and assume that sentences like (3) are in fact a species of biscuit conditional. For reasons that will become apparent below, we will call them *discourse-structuring* conditionals. The insight that biscuit conditionals can fulfill different functions in the discourse is not new; for instance Günthner (1999) proposes to distinguish between the categories of discourse-structuring conditionals, meta-communicative conditionals, and relevance conditionals. The goal of the present section is to investigate the properties of hypothetical conditionals, biscuit conditionals, and discourse-structuring conditionals, and to identify which properties are shared and which are not. I will use the term *biscuit conditional* to refer to conditionals which can co-occur with past reference, but which have a biscuit interpretation (i.e., whose speaker is taken to be committed to the truth of the consequent in the actual world), and reserve the term *discourse-structuring conditional* to the conditionals that are the focus of this paper.

We observe that hypothetical and biscuit conditionals, but not discourse-structuring conditionals, can occur with past temporal reference. Consider first the hypothetical conditionals in (4) and the biscuit conditionals in (5).

(4) HYPOTHETICAL CONDITIONAL
  a. If Alex is in San Francisco right now, she is having iced coffee.
  b. If Alex was in San Francisco yesterday, she was having iced coffee.

(5) BISCUIT CONDITIONAL
  a. If you are hungry right now, there are biscuits on the sideboard.
  b. If you were hungry yesterday, there were biscuits on the sideboard.

In the (b) variants of both (4) and (5) the antecedent refers to a time prior to the utterance time, and both sentences are perfectly acceptable even out of the blue. Now compare this to (6) through (9). In these cases, the (a) variant with the antecedent referring to the present utterance time are perfectly acceptable. The (b) variants whose antecedents refer to a time prior to the time of utterance are unacceptable, at least on a biscuit conditional interpretation. Note that when these conditionals are presented out of the blue, it is difficult to imagine a context in which a hypothetical conditional interpretation is available (more on this in section 4).

(6) a. If I am being frank, you look awful.
b. #If I was being frank yesterday, you looked awful.

(7) a. If you promise not to tell anyone, I ran into Alex last week.
b. #If you promised not to tell anyone yesterday, I ran into Alex last week.

(8) a. If you ask me, Alex is getting ready to leave.
b. #If you asked me yesterday, Alex was getting ready to leave.

(9) a. Alex is a little odd if you know what I mean.
b. #Alex was a little odd if you knew what I meant yesterday.

What properties do (6)–(9) have in common, apart from not being able to occur with past temporal reference? In all of these cases the antecedent refers to the present discourse situation instead of facts outside of the discourse situation. Typically, the antecedents of hypothetical and biscuit conditionals refer to facts outside of the discourse situation, such as *if you get hungry* or *if Alex went shopping this morning*. But reference to the current discourse situation is not what makes discourse-structuring conditionals special. Hypothetical conditionals, for instance, can also refer to the utterance situation. In these cases, their antecedents remain compatible with past reference, as illustrated in (10) and (11).

(10) a. If I am being frank, you should tell me.
b. If I was being frank yesterday, you should have told me.

(11) a. If you understand why this is important, I present the next example.
b. If you understood why this was important, I presented the next example.

Another property that discourse-structuring conditionals have is that whether their antecedents are true in the actual world can be decided directly by the interlocutors. Interlocutors can immediately agree on whether *I may be frank* or *You promise not to tell anyone* are true in w_0. Typical antecedents of hypothetical or biscuit conditionals are not like this.

(12) If Alex gets hungry later, there are biscuits on the sideboard.

(13) If Alex went shopping, there are biscuits on the sideboard.

In these cases, the interlocutors cannot decide immediately whether Alex will get hungry later or whether Alex went shopping earlier. Importantly, while hypothetical and biscuit conditionals can also have antecedents whose truth in the actual world can be decided on the spot, discourse-structuring conditionals necessarily have this type of antecedent. There are no discourse-structuring conditionals where the interlocutors cannot decide on the truth of the antecedent based on the current discourse situation.

Finally, discourse-structuring conditionals have one more property in common, to the exclusion of other biscuit conditionals and hypothetical conditionals: the proposition expressed by their antecedents is taken to be true of the discourse situation. Moreover, it corresponds to an action that is taken to have been committed by the interlocutors. For antecedents such as *if I am being frank* this is easy to see: simply by uttering the conditional itself, the speaker is being frank. Moreover, she can decide herself – on the spot, for a given discourse situation – whether to frankly communicate or not. Below we will discuss more tricky cases, such as *if we now turn to page 5* or *if you promise not to tell anyone* where the interlocutors together have to decide to make the antecedent true.

Note moreover that the construction is quite productive: any proposition commenting on the current discourse situation that is taken to be true by the interlocutors can be used as the antecedent of a discourse-structuring conditional.[2] Moreover, they can be combined with consequents that are questions and imperatives as well as declaratives.

(14) a. If we are discussing people's teeth, have you noticed Alex's new crown?
b. If you want to hear my opinion, leave him already!
c. If I can add to this, Alex is also never on time.
d. If I may introduce a new topic, I have finally booked my vacation.
e. If we take it one step further, I suggest we invite Alex.

In sum, we have seen that discourse-structuring conditionals have the following properties.

	hypothetical conditional	biscuit conditional	discourse-structuring conditional
can occur with past tense	✓	✓	✗
q taken to be true in w_0	✗	✓	✓
p can refer to discourse situation	✓	✓	✓
truth of p in w_0 decided immediately	✗	✗	✓
p taken to be true in w_0	✗	✗	✓

3. A unified analysis?

The literature on biscuit conditionals consists of two main lines of argument. Several authors have argued that there is a fundamental difference in the syntax and semantics of hypothetical

[2]The antecedent and consequent propositions also have to be conditionally independent in the sense of Franke (2009) as discussed in section 3.2.

conditionals and biscuit conditionals (e.g., Iatridou 1994, Ebert et al. 2008, 2014, Scheffler 2008, and Siegel 2006).

Others argue that both kinds of conditionals share the same syntax and semantics, and propose pragmatic mechanisms that cause the difference in interpretation (e.g., Franke 2009, Francez 2015, Lauer 2015, Biezma and Goebel this volume).

The data presented in section 2 pose a puzzle for the view that biscuit conditionals have the same syntax and semantics as hypothetical conditionals: if discourse-structuring conditionals are a species of biscuit conditional, and biscuit conditionals have the same syntax and semantics as hypothetical conditionals, then it should follow that discourse-structuring conditionals are acceptable under the same circumstances where hypothetical conditionals are acceptable. In particular, we would expect them to be acceptable with past temporal reference, since hypothetical conditionals and biscuit conditionals are compatible with it. On a non-unified view, we could simply stipulate that discourse-structuring conditionals are not compatible with past temporal reference, or move away even farther from a unified analysis by claiming that the data in (6) through (9) are simply not conditionals at all. This view is unattractive in light of the fact that many languages use the form *if p, q* to express discourse-structuring conditionals.

The arguments in Franke (2009) and Francez (2015) for a unified analysis for hypothetical and biscuit conditionals are convincing. Still, the present section aims to add some additional empirical arguments for a unified analysis. Section 4 then sketches how we can account for the puzzling data in section 2 even within a Franke-style unified analysis.

3.1. A different syntax and semantics

Let us first take a look at some of the empirical differences that are claimed to exist between biscuit conditionals and hypothetical conditionals. Iatridou (1991, 1994) argues that biscuit conditionals in English do not allow *then*-insertion, unlike hypothetical conditionals.

(15) a. If Alex went shopping, then there are biscuits on the sideboard.
b. If you are hungry, (#then) there are biscuits on the sideboard.

Crucially, her analysis rests on this fact: the presence of *then* is what allows the hearer to interpret the consequent with respect to the worlds selected by the antecedent. Conversely, when *then* cannot occur, this interpretation is impossible and a biscuit interpretation is required instead. A more recent discussion of the (pragmatic) role of *then* is found in Biezma (2014), which mostly sets aside the issue of biscuit conditionals. Here I present some conditionals that clearly have a biscuit interpretation even though they contain *then*.

(16) If you are hungry then there is a Sainsbury's just behind the main complex that does a reasonably priced breakfast.

`http://www.lancaster.ac.uk/colleges/graduate/wp-content/uploads/2016/09/DAY-TRIP-TO-CHESTER_CHESHIRE-OAKS.pdf`

(17) If you are hungry, then there is a tempting menu.
http://www.newsshopper.co.uk/news/10879271.PubSpy_reviews_The_Rose_and_Crown__Green_Street_Green/

Thus the empirical claims on which this analysis is based do not hold.

Another empirical difference that is claimed to exist between biscuit conditionals and hypothetical conditionals applies to German (the claim originates in Davison 1983 and is widely cited, e.g. in Iatridou 1994 and Ebert et al. 2008, 2014). It is claimed that word order in the consequent determines whether a conditional receives a biscuit interpretation or a hypothetical conditional interpretation. For conditionals with a preposed antecedent, the verb can occur either as the second constituent (directly following the antecedent) or as the third constituent (following the antecedent and one more constituent). Davison claims that V2 (i.e., with the verb directly following the antecedent) word order in the consequent only allows a hypothetical conditional interpretation, whereas V3 word order (with the verb following the antecedent and another constituent) only allows a biscuit interpretation.

(18) *Wenn du mich brauchst, bin ich in meinem Büro.* V2 WORD ORDER
if you me need am I in my office
'If you need me, I will be in my office.'

(19) *Wenn du mich brauchst, ich bin in meinem Büro.* V3 WORD ORDER
if you me need I am in my office
'If you need me, I will be in my office.'

Davison reports that (18) only has an interpretation as a hypothetical conditional, whereas (19) only has an interpretation as a biscuit conditional. The literature further claims that whenever a conditional with V2 consequent word order occurs where only a biscuit interpretation makes sense, speakers reject the conditional. Some analyses, such as Ebert et al. (2008), crucially rely on this difference for their analysis. They propose that the V3 word order in the consequent of biscuit conditionals is not a speaker preference, but rather grammaticalized. Thus, the consequent V3 word order triggers an obligatory biscuit interpretation even in contexts where world knowledge suggests that this does not make sense. In the same way they propose that consequent V2 word order forces a hypothetical conditional interpretation, again even in contexts where world knowledge suggests only a biscuit interpretation makes sense.

Empirically these claims do not hold. Naturally occurring data suggests that speakers do choose consequent V2 word order in contexts where a biscuit conditional interpretation is necessary, as in (20).

(20) *Wenn du Durst hast, habe ich etwas für dich.*
if you thirst have have I something for you
'If you are thirsty, I have something for you.' Jan Paul: Paul und die Monsterpflanze

Speakers also produce consequent V3 conditionals with a clearly hypothetical conditional interpretation, as in (21).

(21) **Context:** A user on a knitting website is talking about how fast knitters from Finland knit socks.

Die sind so schnell, ich glaube, wenn ich das 'trainieren' würde, ich wäre
they are so fast I believe if I that train would I would.be
nie so schnell!
never so fast
'They are so fast – I think if I 'trained' [speed knitting] I would never be so fast!'

Furthermore there is experimental evidence against the view that syntax determines conditional intepretation. Köpcke and Panther (1989) asked speakers to rate conditional sentences with consequent V2 word order on a 5-point scale where 1 was 'fully acceptable' and 5 was 'not at all acceptable'. Interestingly, speakers rated the sentence *Wenn Sie mich fragen, wird es bald schneien 'if you ask me, it's going to snow soon'* on average at 1.85. The same sentence was rated at 1.73 when *dann 'then'* was inserted. Other biscuit conditionals were less acceptable for the speakers, e.g. *Wenn du durstig bist, ist Bier im Kühlschrank 'If you are thirsty, there is beer in the fridge'* was rated at 2.68 without *dann 'then'*, and 2.73 with *dann*.

In Csipak (2015) I report on an acceptability judgment study I conducted with 24 speakers of Standard German from Göttingen (Lower Saxony). These speakers were asked to rate the acceptability of biscuit conditionals and hypothetical conditionals on a 7-point scale, with 7 being completely acceptable and 1 being completely unacceptable. The results showed that speakers found conditionals with a hypothetical conditional interpretation with the (atypical) V3 word order less acceptable than with V2 word order, both by subject ($F_1(1,23)=218.8$, $p<.001$, $\eta_G{}^2 =.79$) and by item ($F_2(1,11)=195.2$, $p<.001$, $\eta_G{}^2 =.89$). However, the lowest rated conditionals (hypothetical conditionals with V2 consequent word order) were still significantly more acceptable than ungrammatical filler sentences that contained word order violations ($F_1(1,23)=42.00$, $p<.001$, $\eta_G{}^2 =.19$). For the biscuit conditionals, there was a marginal preference for V3 word order.

Thus, while speakers do display a preference for hypothetical conditionals to occur with V2 consequent word order, they do not seem to exhibit a preference for consequent word order for biscuit conditionals. We conclude that speakers are able and willing to assign the less preferred interpretation to both kinds of conditionals where world knowledge makes it necessary. This suggests that the speaker preference for one or the other word order, to the extent that it exists, is not grammaticalized, and it should not be the basis from which we derive an obligatory syntactic or semantic difference between hypothetical and biscuit conditionals.

3.2. The pragmatic view

The previous section has shown that a syntactic or semantic difference between biscuit and hypothetical conditionals runs into empirical problems. We therefore turn to an alternative story proposed in Franke (2009). He argues that biscuit conditionals have the same semantics that we assume for hypothetical conditionals (for example a modal restrictor analysis along the lines of Kratzer 1986, 2012). The difference in interpretation that we observe between biscuit and hypothetical conditionals on this view is not a semantic one, but comes about pragmatically. Franke introduces the notion of conditional independence and proposes that two propositions p and q are conditionally independent if changing one's beliefs about one will not cause a change in one's belief about the other. On his view, hypothetical conditionals are conditionally dependent. Consider the following example.

(22) If Alex went shopping, there are biscuits on the sideboard.

Imagine that the speaker is undecided about whether Alex went shopping, and equally undecided about whether there are biscuits on the sideboard. Upon learning that Alex went shopping (that is, a change in belief about p), the speaker will likely also change her beliefs about whether there are biscuits on the sideboard (that is, a change in belief about q). Compare this to a biscuit conditional such as (23).

(23) If you are hungry, there are biscuits on the sideboard.

Will learning that the addressee is hungry change the speaker's beliefs about whether there are biscuits on the sideboard? World knowledge suggests that it should not. Thus, the antecedent and consequent propositions are *conditionally independent*. Franke proposes that whenever two propositions that are conditionally independent, they are nevertheless linked via a conditional structure, the hearer undergoes the following chain of reasoning:

(24)
a. The speaker used a conditional to link p and q, suggesting conditional dependence.
b. p and q are conditionally independent.
c. The speaker knows that the hearer knows this but used the construction nonetheless.
d. The hearer concludes that the speaker must be uncertain about the truth of p.
e. Since p and q are conditionally independent, the speaker must have independent evidence for the truth of q.

This is how the biscuit interpretation of conditionals like (23) comes about, allowing us to maintain a unified syntax and semantics for both types of conditionals.

What predictions does this proposal make for discourse-structuring conditionals? World knowledge suggests that the antecedent and consequent of a discourse-structuring conditional are conditionally independent.

(25) If you ask me, Alex is tall.

World knowledge suggests that changing one's belief about whether the addressee is asking to hear the speaker's opinion will not change one's belief about whether Alex is tall. So on Franke's view, (25) could be treated as a biscuit conditional. On Franke's view biscuit conditionals and hypothetical conditionals have the same syntax and semantics. This means that we expect discourse-structuring conditionals, which are essentially biscuit conditionals, to have the same properties that hypothetical conditionals have. In particular, they should be able to co-occur with past temporal reference, as biscuit conditionals do (recall the examples (4) and (5) in section 1). But the examples discussed in sections 1 and 2 have shown that this is not the case. In section 4, I argue that there are independent reasons why discourse-structuring conditionals are not available with past temporal reference, and that we can in fact maintain a Franke-style unified analysis nevertheless.

3.3. Present counterfactual uses

Before turning to the analysis, let us briefly consider some additional data. It is well-known that English uses past tense morphology in the antecedents of counterfactual conditionals. Since section 2 has shown that run-of-the-mill past temporal reference is excluded in discourse-structuring conditionals, we might ask what is going on in counterfactuals that use past tense morphology. (26b) illustrates a present counterfactual conditional. Most importantly, we observe the simple past form *was* in the antecedent, and the form *would be having* in the consequent.

(26) a. If Alex was in San Francisco last week, she was having iced coffee.
b. If Alex was in San Francisco right now, she would be having iced coffee.

In recent years counterfactual conditionals like (26b) have received a lot of attention. The past tense morphology in particular has been the subject of much debate. There are currently two lines of argument: some authors propose that the past tense morphology is not semantically interpreted as a 'real' past tense. On this view, the past tense does not refer to a past time, but instead tracks remoteness on another dimension, namely across worlds (see Iatridou 2000, Schulz 2014). Others have argued that the past tense that we observe is in fact interpreted temporally (see for instance Arregui 2009, Ippolito 2013). On this view, the past tense takes us back to a time when the consequent was still a live possibility in w_0.

The two types of accounts differ slightly in the predictions that they make for the availability of discourse-structuring counterfactual conditionals. The fake tense approach assumes that the past tense in the antecedent is not interpreted temporally in counterfactuals like (27). Therefore we conclude that in principle, nothing in this approach directly predicts that discourse-structuring counterfactuals are unacceptable, so long as the antecedent refers to counterparts of the utterance time in counterfactual worlds. And we find some discourse-structuring present counterfactuals that are acceptable, as in (27).

(27) If I was being frank right now, you look awful.

But we also find some discourse-structuring present counterfactuals which are not acceptable, as in (28).

(28) #If you promised not to tell anyone right now, Alex is getting ready to leave.

In fact, the majority of discourse-structuring conditionals seems to behave like (28), i.e., they are unacceptable as counterfactuals as well as with run-of-the-mill past temporal reference. This unacceptability is a puzzle for the fake tense approach since on this view, 'fake' tense should behave differently semantically from 'real' past tense.

The counterfactual-past-as-regular-past ('past-as-past') approaches run into similar but different problems. They assume that a past tense operator takes scope over the entire conditional, which causes the counterfactual interpretation. The simple past observed in the antecedent and the *would* in the consequent are reflexes of this higher past tense operator. Thus in principle this account would predict that neither conditionals with run-of-the-mill past temporal reference nor counterfactual conditionals should be available with a discourse-structuring flavour, and this is indeed what we find for most antecedents – except for (27), which is a puzzle for this view.

But this view has a more serious problem. Speakers of English disprefer biscuit conditionals with consequents containing *would*, as in (29). Note that speakers seem to vary on whether they find a biscuit reading of (29) unacceptable, or whether they simply prefer (27).

(29) #/?If I was being frank right now, you would look awful.

This is true of biscuit conditionals more generally. For counterfactual biscuit conditionals, speakers prefer past tense morphology in the antecedent, but present tense morphology in the consequent. The past-as-past approach to counterfactuals cannot straightforwardly account for this.[3]

(30) a. If you wanted something to nibble on later, there are biscuits on the sideboard.
b. #/?If you wanted something to nibble on later, there would be biscuits on the sideboard.

Solving this puzzle goes beyond the scope of the present paper.

4. My proposal

The present section will make a proposal for how to tackle discourse-structuring conditionals.

A first analysis that suggests itself from examples like (3) is one in terms of self-verifying utterances in the sense of Eckardt (2012). She proposes that utterances are self-verifying iff they become true by virtue of being uttered.

(31) a. I am using a verb.
b. I promise to mow the lawn.

It is easy to see that the speaker of (31a), by virtue of uttering (31a), is making the sentence true

[3]Note that conditionals like (30) are not discussed in Swanson (2013). He only discusses examples were the consequent shows the past tense morphology that is predicted under the past-as-past analyses.

since it contains the verb *am using*. The speaker of (31b) makes a promise by uttering (31b) (the word *promise* is being used *performatively*), and again it is by virtue of being uttered that (31b) becomes true. Now let us consider how to translate this to biscuit conditionals.

(32) a. If I am being frank, you look awful.
b. In all the worlds closest to w_0 where I am being frank, you look awful.

(33) a. By uttering (32a) I am being frank.
b. Thus w_0 itself is the world closest to w_0 where *I am being frank* is true.
c. (32a) is a biscuit conditional; thus the speaker has independent evidence for the consequent.
d. The speaker believes that *you look awful* is true in w_0.
e. (32a) is true in w_0.

(34) *If I am being frank, you look awful.*
a. $\forall$w'$\in max_g(\cap f(w_0) \cup [\![\text{I-AM-BEING-FRANK}]\!]^{w'})$: YOU-LOOK-AWFUL(w')=1 because
b. $\forall$w'$\in max_g(\cap f(w_0)$ $\cup$(**sp** sends **m** to **add** and FRANK(ε, **m**), and R$\subseteq$t(ε) and S$\subseteq$R): **ADD**-LOOKS-AWFUL(w')=1.

The indexicals *sp* for *speaker*, *add* for *addressee*, *m* for *message* and ε for *event* receive their values relative to the utterance context. When the speaker utters *if I am being frank, you look awful*, there is an event ε of sending a message *m*, and the message counts as frank. Without going into the lexical semantics of *frank* in too much detail, let us assume that one of the ways in which a message counts as frank is if it is both true with respect to the speaker's beliefs, and exceeding a contextual standard of what counts as rude. I assume that speakers will in a next step associate the message *m* with the consequent proposition, *q*. We can then verify that the speaker's message (*'you look awful'*) indeed counts as frank. Crucially, the speech time falls into the time of this event. This serves to verify the utterance.

When combined with past temporal reference, the conditional no longer self-verifies the antecedent, causing oddness.

(35) #*If I was being frank yesterday, you looked awful.*
a. $\forall$w'$\in max_g(\cap f(w_0) \cup [\![\text{I-WAS-BEING-FRANK-YESTERDAY}]\!])$:
YOU-LOOKED-AWFUL(w')=1.
b. $\forall$w'$\in max_g(\cap f(w_0)\cup$(**sp** sends **m** to **add** and FRANK(ε, **m**), and R$\subseteq t(\varepsilon)$ and R<S)):
ADD-LOOKED-AWFUL(w')=1.

Here the speaker claims to have made a frank utterance prior to speech time (there was an event ε of sending a frank message *m* which lies before speech time). But because the event connected to the frank message lies before the speech time, it cannot serve as a witness to automatically verify the utterance. The resulting interpretation is a hypothetical conditional about the past ('all the (relevant best) worlds in which I was frank yesterday are worlds in which you looked awful') that is pragmatically odd.

This proposal cannot straightforwardly account for those cases where the addressee is addressed in the antecedent: *if you promise not to tell anyone; if you know what I mean* or even *if we now turn to page 5* are not antecedents that can self-verify; that is, the speaker cannot guarantee that by virtue of uttering the conditional, these antecedents become true. We therefore broaden the proposal to account for these cases.

The intuition we are trying to capture is that by uttering a discourse-structuring conditional, the speaker uses the antecedent to communicate under which conditions she is willing to share the contents of the consequent, and then shares the consequent. This invites the inference that the speaker takes the antecedent to be true. To illustrate, we consider (36).

(36) If you promise not to tell anyone, Alex is asleep.

We can then assign the following semantics to (36).

(37) $\forall$w'$\in max_g(\cap$f(w$_0$)$\cup$(promise(ε, **add**, $\neg$**tell**(**add**, **m**)) and S $\subseteq$R$\subseteq$t(ε)): Alex-asleep(w')=1

In prose, in all the (relevant best) worlds where there is a promising event happening at speech time involving the addressee not telling anyone about message m, q holds. Again I assume that the interlocutors will associate m and q; thus, in all the best worlds where the addressee promises not to tell anyone that q, q holds. Since the antecedent and q are conditionally independent, the speaker is taken to be committed to the fact that q holds in w_0. It is now up to the addressee to ensure that the entire conditional is true in w_0 by simply not telling anyone about q, i.e., by keeping the promise not to tell anyone.

The proposal spelled out for (36) can be extended to other antecedents: *if you know what I mean (by message m)*, *if you ask me (about message m)*, etc.

The analysis also derives why past tense uses are odd.

(38) #If you promised not to tell anyone yesterday, Alex was asleep.

(39) $\forall$w'$\in max_g(\cap$f(w$_0$)$\cup$(promise(ε, **add**, $\neg$**tell**(**add**, **m**)) and R$\subseteq t(\varepsilon)$ and R<S)): Alex-asleep(w')=1

In all the (relevant best) worlds where there was a promising event at some time prior to speech time that involved the addressee not telling anyone about message m, q holds. Again p and q are conditionally independent, but since the antecedent is about whether or not the addressee told anyone about a message m at a time prior to speech time, there is no reason to associate m with q. But without this connection, the conditional is simply uninterpretable on a discourse-structuring interpretation (and it is difficult to imagine a context where a hypothetical conditional interpretation is available).

Before concluding, I will point out that as with other types of discourse effects, we expect that the antecedents of discourse-structuring conditionals should be acceptable with past temporal reference in contexts where they are not used to refer to the present discourse and there is some other interpretation available. This prediction is indeed borne out, as illustrated with (40).

(40) a. If you knew what I meant when I called Alex ‘organized’ yesterday, you will understand what I mean when I call Jesse ‘disorganized’.
b. If I was being frank yesterday I may have offended Alex.
c. If you asked me yesterday, I don’t recall.

All of the conditionals in (40) have reasonable interpretations as hypothetical conditionals. For instance, in (40b) the speaker is unsure whether what she said yesterday counts as frank (presumably she is uncertain whether her statement exceeded the standard for rudeness), and consequently she is unsure whether she offended Alex.[4]

Finally, I speculate on the contextual clues that turn a conditional into a discourse-structuring (biscuit) conditional. Consider (41), which has an interpretation as a hypothetical conditional, but not as a discourse-structuring conditional.

(41) If you promise not to tell anyone, I will tell you a secret.

Given the right context, this example is perfectly acceptable with past temporal reference.

(42) Context: After waking up with amnesia, A and B are trying to figure out what happened the night before.
A: If you promised not to tell anyone, I told you a secret.

On my view, the reason why (42) is acceptable and the reason why (41) is not interpreted as a discourse-structuring conditional is the same. In the antecedent, the speaker is referring to an event of the addressee not telling anyone the message *m*. However, the consequent proposition is both conditionally dependent on the antecedent proposition, and it is also not ‘juicy’, i.e., the interlocutors are unlikely to associate the message *m* with the consequent proposition. Compare this to (43).

(43) If you promise not to tell anyone, I will tell Peter about the baby tomorrow.

We observe that (43) is ambiguous between a biscuit interpretation on which the speaker’s telling Peter is conditionally independent from the addressee agreeing not to tell anyone. On this interpretation, the past tense reading is out.

(44) #If you promised not to tell anyone last week, I told Peter about the baby the next day.

But on a hypthetical conditional interpretation where the two propositions are conditionally

[4]Remember that a verb like *promise* can be used performatively with present temporal reference, and reportatively with past temporal reference.

(i) a. I promise to let you sleep in on Sunday. *performative*
b. I promised to let you sleep in last Sunday. *reportative*

dependent, the past tense interpretation is available.

(45) A and B have amnesia. Looking through the records, they see that B signed a non-disclosure agreement, but they do not find one signed by A. They also read in Peter's diary that someone told him about the baby.
A: If you promised not to tell anyone, I told Peter about the baby.

Thus we conclude that given the particular interplay of context and content that is necessary for a discourse-structuring conditional interpretation, it follows that this interpretation is simply unavailable when the antecedent is interpreted with past temporal reference. But as the examples have shown, there is no reason to assume a separate syntax or semantics for discourse-structuring conditionals. Thus we can maintain a unified syntax and semantics for hypothetical and biscuit conditionals.

5. Conclusion

The present paper has provided some challenging evidence for a unified account of hypothetical and biscuit conditionals: there are some biscuit conditionals that cannot co-occur with past temporal reference, namely discourse-structuring conditionals. This is unexpected given that both hypothetical conditionals and most biscuit conditionals can occur with past temporal reference. I have argued that a unified analysis of the two can be maintained. The reason why discourse-structuring conditionals are unacceptable with past temporal reference has to do with the relationship between antecedent and consequent: the antecedent refers to an event that is assumed to involve the consequent proposition. Such a relationship between antecedent and consequent is not available when the antecedent is temporally located in the past, but the consequent proposition is uttered in the present.

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Bare nouns, number, and definiteness in Teotitlán del Valle Zapotec[1]

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Abstract. How is definiteness expressed in number-marking languages lacking a definite article? May bare nouns in such languages simply be read as definites or indefinites, without constraint? Dayal (2004) demonstrates that the interpretation of bare nouns with respect to definiteness is significantly constrained in Hindi and Russian. In these languages, singular and plural bare nouns present different possibilities for indefinite interpretation, in a way that receives a natural explanation within a neo-Carlsonian theory of noun meaning (Chierchia, 1998). This makes for a close connection between the meanings of bare nouns in English and those in Hindi and Russian. Does this connection extend to the meanings of bare nouns in number-marking languages in general, even outside of Indo-European? In this paper, we demonstrate that the answer is yes. Our evidence comes from bare noun interpretation in Teotitlán del Valle Zapotec, a language of Oaxaca, Mexico. The Zapotec findings closely replicate Dayal's findings for Indo-European languages, providing support for the viability of the neo-Carlsonian approach as a set of constraints on semantic variation in general.

Keywords: Bare nouns, plural, number, definite, pseudo-incorporation, Zapotec

1. Introduction

Teotitlán del Valle Zapotec is a language with a singular/plural distinction and without a definite determiner. Arguments in this language frequently consist of just a bare noun, as in (1).[2]

(1) Ka-zhunih kabai / d-kabai.
PROG-run horse / PL-horse
The horse(s) is/are running.

This paper is about the interpretation of Teotitlán del Valle Zapotec bare nouns, in particular as concerns definiteness and the role of number marking. Conventional wisdom holds that bare nouns in languages lacking definite articles are able to freely function both as definites and as indefinites.[3] If true, this would make bare nouns in such languages quite different from their counterparts in Germanic languages, such as English bare plurals and bare mass nouns. Those arguments are well-known to show a highly restricted range of interpretations, differentiating them both from definites and from ordinary indefinites with the article *a* (Carlson, 1977).

[1]Our deepest thanks are due to language consultants Enedina Bazán Chávez, Tomasa Chávez, Sergio Martínez, and Teresa Martínez Chávez. Thanks as well to audience members at SuB in Edinburgh, and at the Definiteness Across Languages conference in Mexico City.

[2]The TdVZ data in this paper are written in a practical orthography that is similar in pronunciation to Spanish with a few modifications. *ts* and *dz* represent voiceless and voiced alveolar affricates, and *ch* and *dx* their post-alveolar counterparts. *ll* is a geminate alveloar lateral. The following abbreviations are used in TdVZ glosses: ANIM animal gender, COP copula, EMPH emphatic, FUT future, HAB habitual, NEG negation, NEUT neutral (aspect), PERF perfective, PL plural, PROG progressive, PRT particle, SBJ subjunctive, Y.N yes/no question.

[3]See, for instance, Lee (2006: p 9) on closely related language San Lucas Quiaviní Zapotec.

The work of Dayal (2004) poses an important challenge to the conventional wisdom about languages lacking definite articles. In Hindi and Russian, Dayal shows, only definite and kind-level readings are freely available for all arguments. All other types of interpretation are subject to significant restrictions. Bare plural arguments allow indefinite interpretations, but only weak indefinite readings are ever permitted. Bare singular arguments allow indefinite interpretations only in contexts of (pseudo-)incorporation. The distribution of definite and indefinite readings is thus significantly more complex than expected on the conventional view.

What sort of theory is required to account for these restrictions on bare noun interpretation? Dayal shows that the answer is more familiar than might be expected. With only a minor modification, the range of restrictions on bare noun interpretation in Hindi and Russian falls out from Chierchia's (1998) neo-Carlsonian theory for English bare nouns. The overall conclusion is that a unified theory of bare noun interpretation remains in reach, bringing together (number-marking) languages with and without definite articles.

This paper contributes new evidence in support of this conclusion from Teotitlán del Valle Zapotec, a language typologically and genetically distinct from the languages investigated by Dayal. Quite strikingly, the interpretation of singular and plural bare nouns in Teotitlán del Valle Zapotec shows the same intricate distribution predicted by the Dayal/Chierchia theory. In this language, too, only definite and kind-level readings are freely available to all arguments; existential readings show a complex distribution that involves both the number marking of the noun and the argument structure of the verb. Plural and mass bare nouns generally allow existential readings, though only with narrowest scope. Singular bare nouns show existential readings only with narrowest scope and only in contexts of plausible pseudo-incorporation. The findings overall lend support to the theoretical framework of Chierchia (1998) and Dayal (2004), as this approach successfully predicts both the range of readings possible for bare nouns and the way that number marking influences bare noun interpretation. Science depends on replication, and the prospects for formal semantic approaches to linguistic typology depend on teasing apart core constraints on semantic variation from accidental similarities owing to shared history or language contact. By showing that a familiar system for bare noun meaning is active in an unrelated, geographically distant language, this study suggests that core mechanisms of semantic competence are involved in regulating the interpretation of bare nouns.

The paper is laid out as follows. In the next section, we introduce Chierchia's (1998) approach to English bare nouns and consider certain of its crosslinguistic predictions, particularly in view of a modification suggested by Dayal (2004). In section 3, we present the core data on bare plural and mass nouns in Teotitlán del Valle Zapotec, showing that they behave as expected in this system. In section 4, we then discuss the special properties of singular kind terms, drawing especially on the discussion in Chierchia (1998); in section 5 we show how this approach leads to correct predictions for the analysis of Teotitlán del Valle Zapotec bare singulars. In section 6, we discuss how the numeral *te* 'one' fits into the system. Section 7 briefly concludes.

We round out this introduction with some background information on Teotitlán del Valle Zapotec and the data presented in this paper. Teotitlán del Valle Zapotec is spoken in Teotitlán del Valle, a community of approximately 5000 people located 25 km outside of Oaxaca City, Mexico. Following a Zapotecanist convention, we henceforth abbreviate the language name as TdVZ. The language shows VSO word order with SVO as a common alternant. TdVZ data in this paper were elicited from four speakers, three of whom reside in Teotitlán del Valle; one speaker belongs to the diasporic community in California. Semantic data were obtained through three methods. The primary method was standard semantic elicitation of the type described in Matthewson (2004), involving translation between TdVZ and Spanish (for speakers in Mexico) or English (for the speaker in California) as well as judgments of the felicity of TdVZ sentences in particular contexts. The secondary methods involved a prompted narrative task, where the speaker was asked to provide TdVZ descriptions for portions of a pair of wordless picture books (Mercer Meyer's *Frog on his own* and *A boy, a dog, and a frog*), and act-out tasks, where the speaker was asked to narrate a series of actions performed by the fieldworker.

2. Interpreting bare nouns

In this section we introduce Chierchia's (1998) approach to English bare nouns and Dayal's (2004) extension of that approach to languages lacking definite articles.

2.1. Bare nouns in English

As is well-known, bare nouns in English support three major readings. On the first reading, the bare plural or mass noun functions as the name of a kind. This allows it to serve as the argument of a predicate like *common, extinct* or *rare*, which apply to kinds but not to individuals.

(2) a. Cats are common. b. Gold is rare.

The second reading is the closely related generic reading. The bare noun continues to describe a species or (natural) kind, but the predicate is one that may also apply to particular individuals.

(3) a. Cats purr. b. Gold is shiny.

The third reading is one where the bare noun is felt to contribute not a kind, but a set of instances of that kind. The sentence is understood with existential quantification over these instances.

(4) a. Cats are purring. b. Gold is missing from the safe.

The basic task for theories of bare noun interpretation in English is to explain how bare arguments can span this range of interpretations (but no others).

In presenting the approach pursued by Chierchia (1998) and taken up by Dayal (2004), it will be helpful to start with mass nouns. Chierchia proposes that nouns like *gold* inherently denote kinds. Kinds are modeled as individual concepts, mapping any world or situation to the maximal sum of the relevant material (in this case, gold) in that world or situation. Once evaluated at a world or situation, a kind term is of type *e*. This semantic type explains why kind terms may function as arguments without the help of a determiner. The kind-level predicate simply applies directly to the kind-level noun.[4]

(5) Gold is rare. $rare(GOLD)$

To handle existential readings, Chierchia (developing ideas from Carlson 1977) proposes a special composition operation that applies as the kind-denoting argument combines with the predicate. This operation, 'Derived Kind Predication' or DKP, introduces local existential quantification over instances of the kind. In so doing, it makes use of the operator $^{\cup}$ 'Up' which maps kinds to properties, (6). The DKP rule itself is defined as in (7).

(6) Let d be a kind. Then for any world s, (Chierchia, 1998: 350)
$$^{\cup}d = \begin{cases} \lambda x\ [x \leq d_s],\ \text{if } d_s \text{ is defined} \\ \lambda x\ [FALSE],\ \text{otherwise} \end{cases}$$
where d_s is the plural individual that comprises all of the atomic members of the kind.

(7) *Derived Kind Predication (DKP):* (Chierchia, 1998: 364)
If P applies to objects and k denotes a kind, then $P(k) = \exists x[^{\cup}k(x) \wedge P(x)]$

The existential quantification introduced by DKP is necessarily limited in scope; it applies as soon as the predicate composes with its arguments. This explains why the existential quantification associated with bare arguments standardly fails to outscope negation (Carlson, 1977).

(8) John didn't find gold. $\neg\exists x[^{\cup}GOLD(x) \wedge find(j,x)]$

Partially similar mechanisms are proposed for the generic reading, which plays a relatively more minor role in the overall system. In this case the generic operator is restricted by a description obtained from the kind-level argument via accommodation; the restriction contains a variable over instances of the kind, via the freely available shifter $^{\cup}$ (Chierchia, 1998: 366-7).[5]

(9) Gold is shiny. $Gn_{x,s}[^{\cup}GOLD(x) \wedge C(x,s)][shiny(x,s)]$

For count nouns, Chierchia proposes a basic property-type denotation. Singular count nouns like *cat* denote singular properties (sets of cat-atoms) whereas plural count nouns like *cats* denote plural properties (sets of sums of cat-atoms). The plural property is similar to a mass property in that it has a supremum; we may speak, relative to a world or situation, of the maximal sum of cats or of gold in that world or situation. The intensionalization of this sum is formally identified with the kind. To map plural properties to kinds, Chierchia introduces the operator $^{\cap}$ 'Down':

(10) For any property P and world/situation s, (Chierchia, 1998: 351)
$$^{\cap}P = \begin{cases} \lambda s\ \iota x[P_s(x)],\ \text{if } \lambda s\ \iota x[P_s(x)] \text{ is in the set K of kinds} \\ \text{undefined, otherwise} \end{cases}$$

[4]Here and below, we use capital letters for names of kinds.

[5]Following Chierchia, C is a contextual variable restricting the individual (x) and situation (s) arguments the *Gn* operator ranges over.

Application of $^{\cap}$ to the plural property $[\![cats]\!]$ produces a kind, CAT. Supposing $^{\cap}$ is freely available as a type shift, bare plurals will freely shift to a kind-level interpretation. Evaluated at a particular world or situation, the noun will then be able to function as a bare argument of type *e*, much as mass nouns do. As a kind term, it will be able to give a kind-level reading; a narrow scope existential reading, via DKP; or a generic reading, via accommodation and $^{\cup}$.

(11) Cats are common. $common(^{\cap}cats)$

(12) I don't see cats. $\neg\exists x[^{\cup\cap}cats(x) \wedge see(I,x)]$

(13) Cats purr. $Gn_{x,s}[^{\cup\cap}cats(x) \wedge C(x,s)][purr(x,s)]$

This system provides an initial explanation for why singular count nouns cannot function as bare arguments in English, in view of the definedness conditions of $^{\cap}$. This operation is undefined when applied to a singular property like $[\![cat]\!]$, given that a single individual cannot be a kind.[6] Unable to type shift, the singular noun *cat* thus remains strictly property-type. This explains why it cannot function as an argument without the help of a determiner or quantifier.

This explanation is potentially threatened if additional type shifts beyond $^{\cap}$ are available in natural language. Chierchia proposes that two additional type shifts are indeed available. One is the ι type shift, forming definite descriptions. The other is the $\exists$ type shift, forming existential generalized quantifiers. These type shifts cannot be applied to English bare singulars because lexical determiners *the* and *a* are available with these denotations. This result is ensured by the principle in (14).

(14) *Blocking Principle:* (Chierchia, 1998: 360)
For any type shifting operation τ and any X: $*\tau$(X)
if there is a determiner D such that for any set X in its domain, D(X) = τ(X)

The Blocking Principle ensures that bare nouns in English never receive definite interpretations; this is always blocked by *the*. It also ensures that singular count nouns never receive indefinite GQ interpretations; this is always blocked by *a*. Whether indefinite GQ interpretations are expected for bare plurals depends on the analysis accorded to plural determiner *some*: if treated as a pure existential quantifier, it is expected to block existential readings for bare plurals. Chierchia proposes that *some* not be treated in this way, and thus that existential GQ readings are in principle available to bare plurals. This allows him to explain why the bare plural is associated with an existential quantifier scoping over negation in examples like (15). That example demonstrates a scope pattern which is unavailable in simpler cases like (16).

(15) John didn't fix parts of this machine. $\exists x[\textit{parts-of-this-machine}(x) \wedge \neg fix(j,x)]$

(16) John didn't fix coffee machines. $\neg\exists x[\textit{coffee-machines}(x) \wedge fix(j,x)]$
$(= \neg\exists x[^{\cup}\textit{COFFEE-MACHINE}(x) \wedge fix(j,x)]\ )$

[6]On the singular definite generic, see section 4.

Table 1: Interpretations of English bare nouns (after Chierchia 1998)

		Bare mass noun	Bare plural	Bare singular
a)	Kind-level reading	Available N is kind-denoting	Available $^\cap$ type shift	Unavailable $^\cap$ undefined
b)	Narrow scope existential reading	Available N denotation + DKP	Available $^\cap$ type shift + DKP	Unavailable $^\cap$ undefined
c)	Definite reading	Unavailable ι blocked by *the* and outranked by $^\cap$	Unavailable ι blocked by *the* and outranked by $^\cap$	Unavailable ι blocked by *the*
d)	Wide scope existential reading ($\exists$ GQ interpretation)	Unavailable $\exists$ outranked by $^\cap$; available only if $^\cap$ is undefined	Unavailable $\exists$ outranked by $^\cap$; available only if $^\cap$ is undefined	Unavailable $\exists$ blocked by *a*

Why is a wide scope existential reading available in (15) but not in (16)? Chierchia builds on Carlson's intuition that the crucial factor is that not every plural property corresponds to a kind. Notably, *coffee machines* is considerably more amenable to a kind-level analysis than is *parts of this machine*. Suppose, therefore, that *parts of this machine* is undefined in combination with $^\cap$, as the sum of the machine's parts is not a kind. This means that the default $^\cap$ type shift for the bare plural cannot be applied, and an alternative option must be chosen. Chierchia proposes that the availability of alternatives is regulated by a hierarchical ranking as in (17).

(17) *Ranking of Type Shifts (to be revised)*:
$^\cap > \{\iota, \exists\}$

Because *coffee machines* is capable of shifting via $^\cap$, this is the only possibility. The result is a kind-level denotation which may lead to an existential reading only via DKP. For *parts of this machine*, by contrast, the kind-level reading is off the table and the lower ranked $\exists$ type shift may be used. This makes *parts of this machine* a quantificational expression which is capable of scoping over negation in (15).

The overall view of English bare nouns is summarized in Table 1; note that here and elsewhere, we set aside the generic reading.[7] With that proviso, the only available readings of bare nouns are in the unshaded cells of rows (a) and (b). The unattested readings in rows (c) and (d) are absent due to the combination of the Blocking Principle and the Ranking of type shifts (in some cases redundantly), as discussed above for count nouns. The same logic may be applied to mass nouns if these nouns can shift to properties, via $^\cup$, from their basic kind-level denotations.

[7]This omission is due both to the relatively minor role of the generic reading in the Chierchia/Dayal system and to the well-known interaction between generic readings and verbal morphology. This interaction means that significant further work on the tense/aspect/mood system of TdVZ will be necessary before major claims about generic sentences are made.

Bare singulars turn out not to make viable arguments in English in view of two factors working together. On one hand, the undefinedness of $^\cap$ in combination with a singular prevents kind-level readings; this prevents narrow scope existential readings by blocking the proper setup for DKP. On the other hand, the lexical determiners *the* and *a* block the application of the other two type shifts, ι and $\exists$, which otherwise would be available to the bare singular.

2.2. Predictions for languages lacking a definite article

Several regions of Table 1 deserve special attention in connection with languages lacking definite articles. In this section, we focus on those that concern plurals and mass terms. We return to special issues in the analysis of bare singulars in section 4.

The first point of interest concerns row (c), the definite reading. On Chierchia's approach, the absence of a definite reading for English mass nouns and bare plurals is redundantly ruled out by blocking and by ranking of type shifts. Since the ι operator is ranked below $^\cap$, a definite reading is not expected for bare mass nouns and bare plurals even in a language lacking definite articles, so long as $^\cap$ is defined. Dayal (2004) proposes a modification to the ranking of type shifts which speaks to this point. The proper ranking, she proposes, is not (17) but (18).[8]

(18) *Revised Ranking of Type Shifts*:
$\{\iota, ^\cap\} > \exists$

With this revision, the absence of definite readings for bare nouns in English is entirely due to the presence of a definite article in the lexicon. A language lacking a definite article is expected to allow its bare nouns to type shift via ι as well as via $^\cap$. Bare nouns in such a language should allow a definite reading in general, alongside the kind-level and narrow scope existential readings available for bare plurals and bare mass nouns.

Dayal's revision to the ranking of type shifts has an additional consequence in row (d), the wide scope existential reading. In a language which uses an ι type shift instead of a definite article, the ι shift, which is always defined, will always outrank $\exists$. This means that bare plurals and mass terms should never allow wide scope existential readings.

Finally, a comment is in order on row (b), the narrow scope existential reading, for reasons external to the system itself. Many languages have some variety of incorporation construction available to objects and sometimes to unaccusative subjects. Incorporated nominals standardly receive narrow scope existential readings, just like English bare mass nouns and bare plurals.[9] In languages with 'pseudo-incorporation' (Massam, 2001), incorporated nominals may look morphosyntactically quite similar to their non-incorporated counterparts. In such languages,

[8] Dayal (2013) takes another step in this direction by proposing that $\exists$ type shifts are in fact not available in natural language and not implicated in examples like (15). This proposal leads to the view that ι and $^\cap$ are freely available, unranked options available to bare nouns, making (18) unnecessary as part of the theoretical machinery. The reader is referred to Dayal's paper for full details. Note that nothing in the present analysis depends on the decision between this view and the view discussed in the text.

[9] Indeed, this similarity is at the heart of work by van Geenhoven (1998).

Table 2: Expectations for bare mass and plural nouns in languages lacking definite articles

		Bare mass noun	Bare plural
a)	Kind-level reading	Expected N is kind-denoting	Expected $^{\cap}$ type shift
b)	Narrow scope existential reading	Expected N denotation + DKP	Expected $^{\cap}$ type shift + DKP
c)	Definite reading	Expected $^{\cup}$ + ι type shift	Expected ι type shift
d)	Wide scope existential reading ($\exists$ GQ interpretation)	Unexpected $\exists$ outranked by ι	Unexpected $\exists$ outranked by ι

care must be taken to tell apart those narrow scope existential readings produced by DKP versus those produced by incorporation. This may be done by consideration of the argument-structural role of the bare nominal. Crosslinguistically, incorporation does not apply to external arguments (Mithun 1984, Baker 1988); no such restriction is placed on DKP. Therefore, a narrow scope existential reading for an external argument must be due to DKP.

The main predictions discussed in this section are summarized in (19), and the overall range of interpretations expected for bare mass nouns and bare plurals in languages without definite articles is schematized in Table 2. The next section shows that the pattern in Table 2 correctly describes the behavior of bare mass and plural nouns in TdVZ.

(19) A language lacking definite articles should ...
   a. allow bare plurals and bare mass nouns to have definite, kind-level, and narrow scope existential interpretations.
   b. not allow bare nouns to have wide scope existential interpretations.
   c. allow bare plurals and bare mass nouns to have narrow scope existential readings both as internal arguments and as external arguments.

3. TdVZ bare mass nouns and plurals

Mass nouns[10] and plural count nouns in TdVZ present a proper superset of the readings available to their counterparts in English. In both languages, these nouns function freely as arguments to kind-level predicates. Various such predicates in TdVZ are Spanish borrowings.

(20) a. Komuun na niis.
   common COP water
   Water is common.

   b. Raar-te na or.
   rare-EMPH COP gold
   Gold is rare.

[10]The mass-count distinction in TdVZ appears to function in a way quite similar to English and Spanish. Mass nouns require measure phrases to combine with numerals, and show sorting/packaging coercions if pluralized. We have found one pair of quantifiers that distinguishes mass vs. count, viz. *suskatih* ‘how much’ vs. *bel* ‘how many’.

(21) a. Komuun-te na d-beez.
common-EMPH COP PL-frog
Frogs are common.

b. Guk d-beez ekstingir.
become PL-frog extinct
Frogs went extinct.

Because mass nouns and plurals may serve as kind terms, they are expected to allow existential readings via DKP. We see an existential reading of a mass term in (22) as well as in (23), where the bare noun is an external argument (ruling out an incorporation analysis).

(22) Context: You notice a water leak on the sidewalk.
Ka-zhi'i niis lo neez.
PROG-spill water on road
Water is spilling on the road.

(23) La b-ain za manch tuwai?
Y.N PERF-make butter stain towel
Did butter stain the towel?

The existential quantifier associated with the mass noun may only have narrow scope. This is readily seen for negation, where the two scope patterns are contrasted in (24) versus (25). Example (24) presents a negative answer to an existential question. Only the $\neg > \exists$ scope pattern constitutes an appropriate answer, and the bare mass noun subject is felicitously used.

(24) Context: Question (23)
A'a', kedih b-ain-di za manch tuwai.
no, NEG PERF-make-NEG butter stain towel
No, butter didn't stain the towel. [$\neg > \exists$]

Example (25) presents a context where only a wide scope existential reading is appropriate; the narrow scope reading contradicts the previous discourse. The $\exists > \neg$ pattern is not possible for a simple negated sentence with a mass subject, as (25a) makes clear. Instead, an apparently biclausal sentence with negation in the lower clause must be used, as in (25b).[11]

(25) Previous discourse:
Bi-la'a te tank chikru bi-zhi'i setih.
PERF-crash one tanker and PERF-spill oil
A tanker crashed and oil spilled out.

a. # Per kedih bi-zhi'i-di setih.
But NEG PERF-spill-NEG oil
But oil didn't spill out. [Consultant: "It's a contradiction."]

b. Per y-u'u tubru' setih kedih bi-zhi'i-di.
but NEUT-be a.little.bit oil NEG PERF-spill-NEG
But some oil didn't spill out.

[11] This example instantiates a pattern of subordination without overt markers of embedded structure, which seems to be widespread both in TdVZ and in nearby Zapotecan languages.

The same range of facts holds of bare plurals. The existential reading of a bare plural and its narrow scope with respect to negation are seen in the question-answer pair in (26). (Further examples of the bare plural scoping under negation are seen in (40a) and (41a) below.)

(26) Q: La ka-yoo d-beni gushadih?
Y.N PROG-eat PL-person grasshopper
Are people eating grasshopper?
A: Kedih ka-yoo-di d-tourist gushadih.
NEG PROG-eat-NEG PL-tourist grasshopper
No tourists are eating grasshopper. [$\neg > \exists$]

Once again, narrow scope existential readings are conveyed with simple bare noun constructions, whereas wide scope constructions use a biclausal alternative, (27b).

(27) a. # Ka-sia d-bekuh, per kedih ka-sia-di d-bekuh.
PROG-howl PL-dog but NEG PROG-howl-NEG PL-dog
Dogs are howling, but dogs aren't howling.
Consultant: "It's contradicting each other."
b. Ka-sia d-bekuh, per y-u'u d-bekuh kedih ka-sia-di.
PROG-howl PL-dog but NEUT-be PL-dog NEG PROG-howl-NEG
Dogs are howling, but there are dogs not howling.

In the facts reviewed thus far, TdVZ mass nouns and plurals match the range of interpretations of their English counterparts. Where the languages diverge is in the availability of the definite reading. In TdVZ, bare mass nouns and plurals freely allow definite readings. Definite readings of both plurals and mass nouns are seen in the short discourse in (28); bare nouns occur here first with existential readings, italicized, and subsequently as anaphoric definites, bolded. Examples (29) and (30) provide similar examples collected via the act-out (29) and storytelling (30) tasks.

(28) Context: I am narrating what is happening in a cooking show I am watching.
a. Raate d-kosiner ri-beki *d-paap* kun *za* le'n perolih.
every PL-chef HAB-put PL-potato and butter in pot
Every chef puts potatoes and butter in a pot.
b. **D-paap** g-ai lo **za**.
PL-potato FUT-cook in butter
The potatoes will cook in the butter.

(29) Y-u'u jug, y-u'u *niis*. Naa gu-da'-a **niis** le'n vas.
NEUT-be juice, NEUT-be water. I PERF-pour-1SG water in cup
I have some juice and some water. I pour the water into a cup.

(30) Context: A boy and his dog are walking through the park, carrying a frog and a turtle in a bucket. [Excerpt from *Frog on his own*]

a. Mientr ri-zaa-d-an, gu-na-d-an *d-maripoos*.
while HAB-walk-PL-HUMAN PERF-see-PL-HUMAN PL-butterfly
While they walked, they saw butterflies.

b. Beez siemprte ri-zhulazu-m r-idie-m. Gu-asia-m.
frog always HAB-like-ANIM HAB-go.out-ANIM PERF-jump-ANIM
B-idie-m le'n kubet.
PERF-go.out-ANIM from bucket
The frog always liked to go out. It jumped. It went out from the bucket.

c. Mientr bekuh kin ka-ye-m **d-maripoos**.
while dog DEM PROG-look-ANIM PL-butterfly
Meanwhile that dog was looking at the butterflies.

In summary, bare mass nouns and plurals in TdVZ allow kind-level readings, narrow scope existential readings, and definite readings; wide scope existential readings are absent. This means that these nouns behave in precisely the way predicted by the Chierchia/Dayal system. They may function as kind terms, giving rise to kind-level and narrow scope existential readings (the latter by DKP). Alternatively, they may type shift via ι, producing definite readings. But they may not type shift into generalized quantifiers with $\exists$, given that ι is higher than $\exists$ on the ranking of type shifts. This reveals an important sense in which the definite/indefinite distinction is not fully neutralized in this language. An important class of indefinite interpretations remains unavailable to bare plurals and bare mass nouns.

4. Interpreting bare singulars

In this section we turn to the predictions of the Chierchia/Dayal system for bare singulars. This case deserves special attention in view of the fact that many languages are able to use singular arguments with kind reference. In English, this is seen as the singular definite generic:

(31) a. The gopher is widespread. b. Babbage invented the computer.

This construction has received a good amount of theoretical and empirical scrutiny.[12] One central puzzle, originally noted by Lawler (1973), is that singular definite generics diverge from bare plurals in their allowance for existential readings. The existential reading of singular definite generics is possible only in cases where the predicate describes "something momentous or significant about the species as a whole" (Carlson, 1977); it is absent in examples like (32b), in contrast to bare plural counterpart (32a).

(32) a. Gophers are eating my tomatoes.
b. The gopher is eating my tomatoes.

[12] See, i.a., Carlson 1977, Ojeda 1991, Wilkinson 1991, Krifka et al. 1995, Chierchia 1998, and Dayal 2004.

A number of different approaches to this puzzle have been explored. On a view like Wilkinson's (1991), where bare plurals are ambiguous between kind-level and indefinite readings, the facts simply show that definite singulars are not similarly ambiguous; they lack indefinite interpretations. On Carlson's (1977) view, adopted and adapted by Chierchia (1998) and Dayal (2004), this explanation is not available; bare plurals always denote kinds. Examples like (31) show that singular definites can denote kinds, too, but (32b) seems to show that this kind-level interpretation is not always available.

The approach taken by Chierchia (1998) responds to the challenge of (31)-(32) by essentially reversing Wilkinson's explanation – treating singular definites, rather than bare plurals, as subject to an ambiguity. The core approach to singular definites is as referential expressions denoting singular collectives. To combine with a kind-level predicate, the singular definite must be mapped to the associated individual concept via abstraction over the world/situation variable. This operation is forced in examples like (31) by sortal restrictions of the predicate. When a singular definite combines with an object-level predicate, as in (32b), however, there is no sortal mismatch to be repaired by intensionalization. This leaves the singular definite without a true kind-level interpretation. It may combine with the predicate only via simple function application, not in the way mediated by DKP.[13]

These considerations lead to the following predictions for singular count nouns in languages lacking definite articles. We saw above that languages lacking definite articles are expected to allow all nouns to type shift via ι, given that this type shift is not lexically blocked. (See (19a).) Bare singulars should thus allow definite readings. If intensionalization is universally available as a type adjustment, then bare singulars should also allow kind-level readings. In contrast, existential readings of bare singulars are expected to be significantly limited. Wide scope existential readings are predicted to be absent, given (at least) that the $\exists$ type shift is outranked by ι.[14] (See (19b).) Furthermore, bare singulars are expected to diverge from bare plurals in the availability of the narrow scope existential reading. Bare singulars cannot obtain narrow scope existential readings by DKP. Narrow scope existential readings for bare singulars could only arise via an independent mechanism, such as incorporation. This means that narrow scope existential readings should always be absent for singulars when they serve as external arguments, given that incorporation is not possible in this argument-structural configuration. The two predictions specific to bare singulars are summarized in (33), and the overall range of expected interpretations for bare singulars is schematized in Table 3.

(33) A language lacking definite articles...
  a. should allow bare singulars to have kind-level or definite interpretations.

[13] An alternative route is explored by Dayal (2004), who posits that singular definites do indeed have true kind-level interpretations without the help of a special abstraction operation. What is key is that singular kind terms block access to their instantiation sets: "the singular kind term is an atomic entity which does not allow distributive predication to entities we intuitively associate with it. That is, it is an atomic term whose only instantiation set, when available, includes perhaps a representative or prototypical object." This means that DKP is unavailable for singular kind terms, blocking the missing reading of (32b). As far as we can tell, this approach is equal in empirical coverage to the Chierchia 1998 view; we adopt the latter for simplicity of exposition only.

[14] See section 6 for additional discussion.

b. should not allow bare singulars to have narrow scope existential interpretations, except via incorporation (if the language makes use of this option); narrow scope existential interpretations should always be absent for singular external arguments, which cannot incorporate.

Table 3: Expectations for bare singulars in languages lacking definite articles

		Bare singular
a)	Kind-level reading	Expected ι + intensionalization
b)	Narrow scope existential reading	Unexpected (modulo incorporation)
c)	Definite reading	Expected ι type shift
d)	Wide scope existential reading ($\exists$ GQ interpretation)	Unexpected $\exists$ outranked by ι

The next section shows that this rather complex set of expectations is again borne out for TdVZ.

5. TdVZ bare singulars

There are three respects in which bare singulars are expected to behave like bare plurals: in allowing kind-level readings, in allowing definite readings, and in disallowing wide scope existential readings. We begin this section with the evidence that these expectations are met.

As expected, kind-level predication may be carried out in TdVZ either via the bare plural or via the bare singular.

(34) a. Guk (d-)beez ekstingir.
become (PL-)frog extinct
Frogs/the frog went extinct.

b. Komuun-te na (d-)beez lo geu.
common-EMPH be (PL-)frog in river
Frogs are / the frog is common in the river.

Also as expected, bare singulars are amenable to definite readings just as their plural counterparts are. Anaphoric singular reference is accomplished with bare singulars in examples like (35) and (36); the relevant definite terms are bolded.

(35) Rap-a te manzan, kon te manguh, per gu-zuub-an **manguh** lo yagzhilih.
have-1SG a apple and a mango but NEUT-sit-3SG mango on chair
I have an apple and a mango but the mango is on the chair.

(36) Context: A boy and his dog are walking through the park with a net, looking to see if they can catch an animal. They come across a frog sitting on a lily pad in a pond.

a. "N-iu'!" n-e-m. "A te beez zu lo nis!"
NEUT-look NEUT-say-ANIM PRT one frog stand on water
"Look!" it [the dog] said. "There's a frog on the water!"

b. Xila'azga, xila'azga, ka-zaa-d-an te neez-d-an **beez**.
slowly slowly PROG-walk-PL-3 PRT catch-PL-3 frog
Slowly, slowly, they walked to catch the frog.

Examples (37) show that bare singulars are also readily used to describe referents that are unique, whether absolutely or relatively.

(37) a. Ziit-te zuub **gubiizh**.
far-EMPH sit sun
The sun is very far away.

b. Rom zu-gua **Paap**.
Rome PROG-be.located pope
The pope lives in Rome.

Finally, bare singulars behave like bare plurals, and as expected, in disallowing wide scope existential readings. Examples (38) and (39) show that bare singulars are rejected in a context calling for the wide scope existential reading; the consultant corrects the sentences to include the word *te* 'one' (discussed in section 6).

(38) Context: there's six frogs and five of them are in the basket. We want to say there's one that's not, so we say:

\# Kedih y-u'u-di beez le'n kanast.
NEG NEUT-be-NEG frog in basket

Speaker's correction:

Kedih y-u'u-di te beez le'n kanast.
NEG NEUT-be-NEG one frog in basket
One frog isn't in the basket.

(39) Context: I'm editing a paper for someone else, and fixing mistakes. I'm expressing my regret because I realize I've sent the paper off and there is a mistake I didn't fix.

a. Kedih b-ain sru-di-a te eror.
NEG PERF-make good-NEG-1 one mistake
I didn't fix a mistake.

b. # Kedih b-ain sru-di-a eror.
NEG PERF-make good-NEG-1 mistake
Consultant: "It's more normal if you say *te eror*."

Discussion of example (39b) revealed that the bare singular object would be improved in this context if modified by a relative clause or a sequence of other modifiers. This additional material presumably rescues the example by improving the felicity of a definite reading, which requires a single salient referent for the object.

This brings us to the point where bare singulars and bare plurals are expected to diverge, namely the possibility of the narrow scope existential reading. Let us begin with those bare arguments not amenable to incorporation. Example (40) contrasts a bare singular and a bare plural subject for the unergative verb *zhiiz* 'laugh'. As we saw above, the bare plural is freely able to show a narrow scope existential reading in this environment; the bare singular, however, is not.

(40) Context: my husband has shared a joke with me and I told it to my class. When I get home, he asks if anyone laughed. I have to report the sad news: no laughing.

a. Kedih ba-zhiiz-di d-bi'in xkuilih.
NEG PERF-laugh-NEG PL-student
No students laughed.

b. # Kedih ba-zhiiz-di bi'in xkuilih.
NEG PERF-laugh-NEG student
Intended: No student laughed. Only possible reading: one student didn't laugh.

Example (40b) is acceptable only on an interpretation where the bare singular picks out a single individual – just what is expected, if it is forced to be definite when serving as an external argument of a non-kind-level predicate. Example (41) shows a similar contrast for transitive subjects. The bare plural is readily able to show the narrow scope existential reading; the bare singular has only a single-individual reading.

(41) The mail carrier is often chased by dogs. Today he comes home and says: *Sru guk nazhi*... [It was a good day...]

a. ... kedih bi-dieno-di d-bekuh naa.
NEG PERF-chase-NEG PL-dog me
No dogs chased me.

b. # ... kedih bi-dieno-di bekuh naa.
NEG PERF-chase-NEG dog me
Intended: no dog chased me. [Consultant: "This sounds like a specific dog."]

It is quite striking that this contrast between singulars and plurals comes out precisely as expected and essentially in parallel with the English facts in (32). The result is even more remarkable if we consider that the contrast collapses for internal arguments – a fact which we propose to attribute to (pseudo)-incorporation. The prototypical incorporated arguments are direct objects, and in TdVZ, narrow scope existential readings are freely available in this case. Example (42) shows that both singular and plural direct objects may scope under a higher intensional operator and quantificational subject. Example (43) provides an additional case of a singular direct object showing a narrow scope existential reading.

(42) Context: Tourists going to Hollywood have a general desire to meet celebrities.

a. Kadga tourist ri-kas gu-mbe beni famos.
every tourist HAB-want SBJ-meet person famous
Every tourist wants to meet a famous person.

b. Kadga tourist ri-kas gu-mbe d-beni famos.
every tourist HAB-want SBJ-meet PL-person famous
Every tourist wants to meet famous people.

(43) Context: I'm going to meet somebody and I want to describe to them what I look like.
Kedih kaa-di zhumbrel kiye-'.
NEG PROG.wear-NEG hat head-1
I'm not wearing a hat.

Subjects of certain intransitive verbs may also show narrow scope existential readings; these verbs are plausibly analyzed as unaccusative. One of these is the (locative) copula *u'u*.

(44) Kedih y-u'u-di beez le'n kanast.
NEG NEUT-be-NEG frog in basket
There's no frog in the basket.

Finally, prepositional objects may show narrow scope existential readings in examples like (28a) above, where pots covary with chefs. This range of facts shows that bare singulars may in principle have narrow scope existential readings, but only by a mechanism that does not apply to subjects of unergative intransitives (40) or to transitive subjects (41). Incorporation is a mechanism that is argument-structure sensitive in precisely this way, and thus, these facts suggest that TdVZ is a language making use of some type of incorporation construction.

These facts are of special interest for the study of incorporation constructions because there is no obvious morphosyntactic difference in TdVZ between clauses with incorporated objects versus those with non-incorporated objects. There is, for instance, no difference in object marking or object agreement (by contrast to Hindi (Dayal, 2011) or Nez Perce (Deal, 2010)), no overt compounding of the verb and the object (by contrast to West Greenlandic (van Geenhoven, 1998)) and no switch from VSO to VOS (by contrast to Niuean (Massam, 2001) or Chol Mayan (Coon, 2010)). This suggests that TdVZ may be a language with *purely* semantic incorporation: the object composes with the verb in a way that facilitates extraordinary narrow scope (perhaps among other semantic effects; see Dayal 2011), but without any special consequence for word order or morphosyntactic marking.

6. Does TdVZ have an indefinite determiner?

The theory presented thus far makes use of two central tools in regulating the interpretation of bare nouns: the Blocking Principle (14) and Ranking of Type Shifts (18). In this section, we consider and reject the possibility that Ranking may be removed from the theory by means of an analysis that reassigns some of its work to Blocking. In particular, we argue that TdVZ does not have indefinite articles (i.e. items that lexicalize the $\exists$ type shift) available for all types of NPs. The best candidate for such an item is *te* 'one', and we argue that this lexical item does indeed create existential GQs; however, it is restricted to singulars or partitive structures. The absence of a wide scope existential reading for mass and plural bare nouns therefore cannot be attributed to Blocking by *te*.

The behavior of *te* 'one' with singulars is in several ways reminiscent of English indefinite article *a*. Like *a*, *te* gives rise to antifamiliarity and antiuniqueness implications, showing effects of Maximize Presupposition (Heim, 1991).

(45) Nau-te te bekuh bedih lele'e. Cha-rilian (#te) bekuh.
chase-EMPH one dog rooster patio. PROG-hungry one dog
A dog is chasing a rooster on the patio. The dog looks hungry. [Consultant: With *te*, it means another dog.]

(46) Rom zu-gua (#te) Paap.
Rome PROG-be.located one pope
The pope lives in Rome [Consultant: with *te*, there is more than one pope.]

Te-phrases are also similar to English *a*-phrases in allowing variable scope with respect to clausemate negation. We have seen *te*-phrases with scope over negation in (38)-(39) above. An example with scope under clausemate negation is shown in (47).

(47) Q: Did Maria buy a chicken?
A: Ketih guzi-di Lie te bedih.
NEG buy-NEG Maria one chicken
Maria didn't buy a chicken. ($\neg > \exists$)

Overall, these facts suggest that singular *te* phrases, like their English *a*-phrase counterparts, are existential GQs. This has the consequence that the absence of a wide scope indefinite reading for TdVZ bare singulars could be attributed to Blocking, rather than Ranking, just like in English. Can the absence of the $\exists$ type shift in TdVZ *in general* be attributed to Blocking, then? No: while *te* can occur in plural DPs (unlike English *a*), *te PL-N* does not behave as an ordinary existential GQ. Rather, plural DPs containing *te* seem to be partitives, often also containing a demonstrative and presupposing the existence of an element in $[\![PL\text{-}N]\!]$ (e.g., in (48), a plurality of tortillas). Also notably, *te PL-N* is never used for an ordinary narrow scope existential reading, unlike in singular examples like (47); bare plurals are used instead.

(48) Bell (lee) ri-ki'ini-u **te d-get kan**, guni-naa.
If (you) HAB-need-2S one PL-tortilla DEM, tell-1SG
If you need some of the tortillas, let me know.
Consultant: This is what you say if you've already made the tortillas.

The interaction with number suggests that *te* is a existential GQ only with a singular complement. Apparent plural complements, like in (48), reflect hidden partitive structure: *If you need* ***one portion of*** *the/those tortillas*.[15] We conclude that blocking by *te* does some, but not all, of the work of ruling out wide scope existential readings for bare nouns. Both Blocking and Ranking are needed in order to fully constrain the interpretation of bare nouns in TdVZ.

7. Conclusions

In this paper, we have demonstrated that TdVZ, while it may lack definite articles, is not a language where definite and indefinite readings are freely available for bare nouns. Rather,

[15] The absence of an overt noun 'portion' here recalls Nez Perce and Yudja, on the analysis of Deal (2017).

(in)definiteness in TdVZ bare nouns is constrained by number and by argument-structural position, and this in precisely the way predicted by the neo-Carlsonian approach to bare noun meaning (Chierchia 1998, Dayal 2004). In corroborating this approach with evidence from Zapotecan, our results lend new support for the neo-Carlsonian theory as a characterization not of an accident of (Indo-)European heritage or history, but rather of Universal Grammar mechanisms at work in number-marking languages.

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Clefts: Quite the contrary![1]

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Abstract.

Much of the previous literature on English it-clefts—sentences of the form 'It is X that Z'—concentrates on the nature and status of the exhaustivity inference ('nobody/nothing other than X Z'). This paper concerns the way in which it-clefts signal contrast. We argue that it-clefts signal a type of contrast that does not merely involve a salient antecedent, as on more traditional characterizations of contrast such as those of e.g. Kiss (1998) and Rooth (1992), but also involves a conflict between the speaker's and the hearer's beliefs, as under the characterization of contrast given by Zimmermann (2008, 2011), which we term *contrariness*. Results of a felicity judgment experiment suggest that clefts do have a preference for contrariness, and one which has a gradient effect on felicity judgments: the more strongly interlocutors appear committed to an apparently false notion, the better it is to repudiate them with a cleft.

Keywords: English it-clefts, contrast, interlocutors' expectations, existential inference.

1. Introduction

As discussed by Horn (1981: 127), Halvorsen (1978) identified three meaning components for English it-clefts of the form "It is X that V-ed". Consider the following example:

(1) It's David who smiled.
  a. David smiled.
  b. Someone smiled.
  c. No one other than David smiled.

The cleft sentence (1) gives rise to the three implications in (1a)-(1c): the PREJACENT INFERENCE (1a), i.e. the proposition expressed by the canonical form 'X V-ed', an EXISTENTIAL INFERENCE (1b) such that there exists an X who V-ed, and an EXHAUSTIVITY INFERENCE (1c), such that X identifies the sole (or maximal) entity of which V holds.

A great deal of the subsequent work on clefts has been dedicated to the exhaustivity implication, aiming both to give a precise characterization of its content and to identify its discourse status, i.e. whether it is conventionally encoded within the cleft itself, or arises from pragmatic reasoning on the discourse context (e.g. Halvorsen 1978, Atlas and Levinson 1981, Wedgewood 2007, Velleman et al. 2012, Büring and Kriz 2013, Destruel et al. 2015).

But clefts have also been posited to express a *contrast*, and indeed this tradition dates back to the work in which the term "cleft" was first introduced. Thus we find in Jespersen (1927),

[1]We would like to thank the audience of the SuB 2016 conference for their helpful comments on this work.

which is perhaps the first general treatment of clefts, "A cleaving of a sentence by means of *it is* (often followed by a relative pronoun or connective) serves to single out one particular element of the sentence and very often, by directing attention to it and bringing it, as it were, into focus, to mark a contrast." (Jespersen 1927: 147f.). Later work discussing clefts' contrastive function includes É. Kiss 1998, Patten 2012: 85ff, Destruel and Velleman 2014, and Umbach 2004, p. 4 who follows É. Kiss.

In the literature, the notion of *contrast* is often discussed in relation to two other primitives of information structure, topic and focus. Since clefts are known to be focus-marking devices, we will be interested in contrast in focus-related contexts. We take focus to be the part of the sentence that evokes a set of alternatives relevant for the interpretation of that sentence, and which is taken to be salient by the speaker (Rooth, 1985, 1992; Krifka, 2007). Now, turning to contrastive focus, several definitions have been offered. É. Kiss (1998: 267), takes an *identificational focus* to have the feature [+contrastive] "if it operates on a closed set of entities whose members are known to the participants of the discourse [. . .] In this case, the identification of a subset of the given set also identifies the contrasting complementary subset." Rooth (1992) defines contrast as a subcase of a more general notion of focus; for Rooth, a phrase α should be taken as contrasting with a phrase β if the ordinary semantic value of β is a subset of the focus semantic value of α.

But, as Zimmerman (2008) points out, the two approaches described above do not fully predict when contrast-marking constructions such as clefts will be used. In languages as diverse as Finish and Hausa, which are argued to use clefts to indicate exhaustivity or the presence of an antecedent, canonical sentences can sometimes be used when an exhaustive or a contrastive meaning is intended, and an explicit antecedent is present. This is illustrated in Hausa in example (2) (taken from Zimmerman 2008: 351), where Speaker B uttering (2b) corrects Speaker A uttering (2a). This suggests that there may not be a strict one-to-one correspondence between a certain focus interpretation, i.e. here contrastive, and the way in which it is realized grammatically.

(2) a. You will pay 20 naira.
b. A'a zâ-n biyaa shâ bìyar̃ nèe.
no, FUT-1SG pay fifteen PRT
'No, I will pay [fifteen.]$_f$'

As opposed to Kiss and Rooth, Zimmerman (2008) argues for a notion of contrast that calls on *hearer expectation*, i.e. whereby a focused constituent α is a contrastive focus whenever the speaker assumes that "the hearer will not consider the content of α or the speech act containting α likely to be(come) common ground" (Zimmerman, 2008: 9). Since it relates to speaker and hearer belief, it can be thought of as *doxastic contrast*, but to avoid confusion with existing notions of contrast, we will use the term *contrariness*.

With these distinctions in mind, let us distinguish among three imaginable hypotheses:

- Hypothesis A: The meaning components identified by Halvorsen (1978) (the Halvorsen components) are sufficient to capture the significance of a cleft construction.

- Hypothesis B: In addition to the Halvorsen components, clefts signal a non-doxastic type of contrast, of the type characterized by É. Kiss (1998) or Rooth (1992).

- Hypothesis C: In addition to the Halvorsen components, clefts signal a doxastic type of contrast, i.e. contrariness.

Hypothesis B is appealing, at least at first sight, because it accounts for some important judgments such as the observation that, while it-clefts often sound odd as direct answers to overt questions, as in (4) (see also results from Destruel and Velleman 2014 who find this context to lead to the lowest naturalness ratings for clefts), they often sound much better as corrections, as in (3).[2] In this case, the previous utterance being corrected provides exactly the kind of antecedent that Rooth mentions for a contrastive focus.

(3) A: I wonder why Alex cooked so much beans.
B: Actually, it was John who cooked the beans.

(4) A: Who cooked the beans?
B: #It was John who cooked the beans.[3]

However, Hypothesis B is not without limitations. There are certain observations that it cannot explain. For instance, in contexts in which an antecedent *is* available, speakers may nevertheless choose not to use a cleft. Indeed, in some such contexts, clefts seem actively dispreferred, and their use sounds stilted and odd. For instance, (5b) does not strike us as good idiomatic English. This is confirmed in the rating experiment conducted by Destruel and Velleman (2014) where this particular sentence was actually given a lower naturalness rating than (6b), despite the fact that (5b) has an antecedent available (viz. Canada) and (6b) does not.

(5) A: Darren sounded really excited about his vacation. I think he might be going to Canada.
a. B: Actually, he's going to Mexico.
b. B: ? Actually, it's Mexico that he's going to.

(6) A: We were planning Amy's surprise party for weeks. I can't believe she found out about it. Who told her about it?
a. B: Ken told her about it.
b. B: It was Ken who told her about it.

So, we are still left with the question: If the mere presence of an antecedent is not "enough" to drive the naturalness ratings of a cleft up, what else is needed to make it-clefts good? In this paper, we will follow Zimmerman's (2008) notion of contrast and set out to test Hypothesis

[2]Indeed, our invocation of *contrariness* could be seen as an implementation of the notion of *corrective focus*: see e.g. Gussenhoven 2008. However, there are some cases where contrariness could be argued to be at play that do not involve what one would be inclined to call corrections, including "Either Mary ate the beans, or it was John who ate them." For this reason, we take it that correction, although it is a possible use of clefts, is not what clefts mark.

[3]Throughout the paper, we will indicate ungrammaticality with an asterisk (*) and infelicity with a hash (#).

C. We will give experimental evidence showing that *contrariness* has a positive and gradient effect on the felicity of clefts: The more there is a contrast in expectation between the speaker and the hearer, the better clefts are.

2. Experiments

The core idea behind the set of experiments presented hereafter (two pre-tests and one main study) is to test Hypothesis C described in the introduction: the more strongly an interlocutor appears committed to a (false) proposition, the better it is to repudiate them with a cleft. This means that the presence of a focal antecedent in the discourse, although maybe necessary, is not a sufficient use-condition for it-clefts. Rather, it is when they are used as a response to an (explicit) contrary claim that clefts are most felicitous.

2.1. Design and Material

In all experiments below, the same source sentences were used to generate the stimuli that were provided to subjects, and the stimuli were always presented in written form. In the main study, the stimuli consisted of a short dialogue between Speaker A who provided the context, and Speaker B who provided the contrary comment. A's part, as illustrated in (7), always contained three sentences, the first two establishing the context and the last one containing the information on which B's comment was based. Experimental items varied depending on the form of the last sentence in A's discourse across six possible contexts. The six different contexts were designed to vary along three dimensions: (i) CONTRADICTION, i.e. whether or not the information in B's sentence contradicted the information stated in the last sentence uttered by A, (ii) COMMITMENT, i.e. the strength with which A was committed to their statement (as measured in a pre-test), and (iii) AT-ISSUENESS, i.e. whether or not the relevant proposition in A's speech commented on by B was at-issue. B's part was always either in a canonical form or a cleft form. When A's context was non-contradictory (context 1), B's sentence was always introduced by "Yeah,...", while in the other contexts (contexts 2 through 6), B's sentence was introduced by "Actually,...". The different conditions are summarized in Table 1, and an illustrative sample is given in (7)–(8).

	Contradiction	Strength of Commitment	At-issueness
1- Non-contradictory	no	+	no
2- Weak at-issue	yes	++	yes
3- Weak non-at-issue	yes	+++	no
4- Strong at-issue	yes	++++	yes
5- Strong non-at-issue	yes	+++++	no
6- Presuppositional	yes	++++++	no

Table 1: Conditions for A's last sentence.

(7) **Contexts (sample lexicalization)**
Speaker A: We were planning Amy's surprise party for weeks. I can't believe she found out about it. [...]
a. Context 1: ... I guess someone from the staff told her.

b. Context 2: ... I guess Alice must have told her.
c. Context 3: ... And Alice—who I think, probably went and told her about it—just laughed and said it was no big deal!
d. Context 4: ... Alice told her about it, you know.
e. Context 5: ... And Alice—who went and told her about it—just laughed and said it was no big deal!
f. Context 6: ... I'm annoyed that Alice told her about it!

(8) **Sentences to rate (sample lexicalization)**
Speaker B: (Yeah/ Actually,) [...]
a. Ken told her about it.
b. it's Ken who told her about it.

Finally, we also controlled for the GRAMMATICAL FUNCTION of the element that B commented on, i.e. a grammatical subject or an object. Example (7) above illustrates the subject condition. An example of the object condition for context 1, i.e. the non-contradictory context, is given below in (9):

(9) a. Speaker A: Look at John this evening! He's all dressed up. [...] I guess he's going out with someone from the marketing team.
b. Speaker B: Yeah, he's going out with Karen/ Yeah, it's Karen he's going out with.

We created a total of 12 lexicalizations for each contexts, thus 72 experimental dialogues per grammatical function (or 144 total). Three groups of participants were recruited. Participants in the main study were asked to judge the naturalness of B's part based on A's. In pre-test 1 and pre-test 2, the two different groups of participants only saw and rated A's part. The specifics of each task are discussed in more details hereafter in subsections 2.2-2.4.

2.2. Pre-test 1: Strength of existential inference

Motivation: It is important for our argument that any effect we find of doxastic contrast is not an artifact of variation among items with respect to the strength of the existential inference that they give rise to. We therefore carried out a pre-test in order to measure the strength of the existential inference in A's part, in other words, how strongly A believes that someone V-ed.

Procedure: In this task, participants only saw and judged A's discourse. A total of 65 participants, all undergraduates at the University of Iowa, were recruited from a first-year language class and given extra-credit for their participation. The test was delivered via the web-based survey site Qualtrics. Participants sat in front of a computer screen and read a total of 24 contexts (A's part) pseudo-randomized among 24 fillers. On each trial, they saw Speaker A's sentences and were asked to judge, on a scale from 1–7, how likely it is that the speaker thinks that somebody V-ed. So for instance, given context 1 in (7a) above, participants would be asked how likely is it that someone told Amy about her surprise party (1 corresponding to extremely unlikely, and 7 to extremely likely).

Results: Mean naturalness ratings for the strength of the existential inference in A's sentence are presented in Table 2. Overall, we observe that participants deem the likelihood of speaker thinking that someone V-ed lower for the context that lacks a contrast between A's sentence and B's response (i.e. context 1), versus other contexts. The data were analyzed using a mixed effect linear regression model to predict ratings with by-participant and by-item random intercept, and contrast as a factor (sum-coded as -1/1 for context 1 vs. others, respectively). Results reveal a significant effect of CONTRAST on existential ratings (β = 2.043, SE = 0.091, t = 22.24, p < .001), suggesting that, indeed, there was a significant difference in ratings between context 1 and the others where a conjecture was present.

Context	Mean ratings (Subject)	Mean ratings (Object)	Overall ratings
1- Non-contradictory	4.6	4.4	4.5
2- Weak at-issue	6.5	6.3	6.4
3- Weak non-at-issue	6.5	6.5	6.5
4- Strong at-issue	6.6	6.7	6.7
5- Strong non-at-issue	6.4	6.4	6.4
6- Presuppositional	6.7	6.7	6.7

Table 2: Mean naturalness ratings for Pre-test 1.

Crucially though, focusing on the contradictory data set, we see that contexts 2-6 do not significantly differ from each other with respect to A's commitment to existence. This is good news: If we further find that these contexts differ in the strength of A's commitment to a statement that B will contradict (as they were designed to do and tested in pre-test 2), then we will be able to test our prediction as stated in Hypothesis C.

2.3. Pre-test 2: Strength of commitment

Motivation: Recall that we designed for four levels of commitment strength, namely *non-contradictory*, *weak*, *strong* and *presuppositional*, with the underlying assumption that commitment would get increasingly stronger in these contexts. In pre-test 2 we measured commitment strength (how strongly committed A is to 'X V-ed') directly. This gave us a more accurate measure of this factor to use, and allowed us to confirm that the contexts we created were indeed, as they were designed to be, different from each other with respect to the strength of commitment of Speaker A to the prejacent proposition in their last utterance (the target proposition).

Procedure: A total of 65 participants were recruited, different from those who took part in pre-test 1. They were all undergraduates at the University of Iowa. They were enrolled in a first-year language class and were given extra credit for their participation. The test was delivered via Qualtrics. Participants sat in front of a computer screen and read a total of 24 contexts (A's part) pseudo-randomized among 24 fillers. On each trial, they saw Speaker A's sentences and were asked to judge, on a scale from 1–7, how strongly Speaker A is committed to the fact that X V-ed. So for instance, given context 1 in (7a) above, participants would be asked how strongly is Speaker A committed to the proposition that someone from the staff told Amy about her surprise party (with 1 corresponding to extremely uncommitted and 7 to extremely committed).

Results: Mean naturalness ratings are reported in Table 3. Overall, we observe that the context with the lowest rating, as predicted, is the one where there is no contradiction (context 1). We then observe a strengthening trend, with contexts 4–6—which we designed as containing a stronger commitment of A to the prejacent proposition—being rated higher than contexts 2–3, which were meant to weakly commit A to the prejacent. This result is welcome and suggests that there is indeed a difference between contexts in A's degree of commitment to the prejacent.

Context	Mean ratings (Subject)	Mean ratings (Object)	Overall ratings
1- Non-contradictory	2.2	2	2.1
2- Weak at-issue	3.6	3.9	3.8
3- Weak non-at-issue	2.7	2.6	2.7
4- Strong at-issue	6.1	6.1	6.1
5- Strong non-at-issue	5.5	5.3	5.4
6- Presuppositional	5.3	5.6	5.5

Table 3: Mean naturalness ratings for Pre-test 2.

The results from the two pre-tests are illustrated in relation to each other in Figure 1. Recall that contradictory contexts (2–6) all provide an antecedent and commit Speaker A to existence (illustrated by the fact that ratings on the x-axis are homogeneously high). But, importantly, we observe that they differ in the strength of A's commitment to a statement that B will contradict, which allows us to test Hypothesis C.

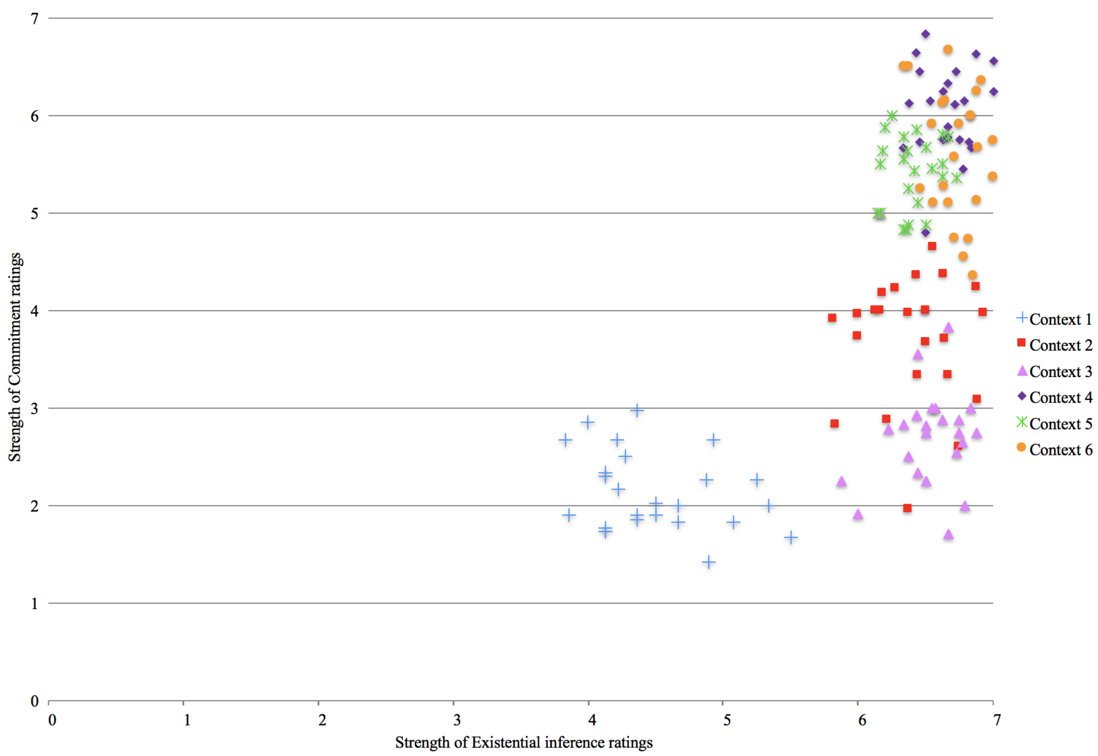

Figure 1: Existential * Strength of commitment.

2.4. Main study

Goal: The overarching goal of the main study is to test Hypothesis C. We investigated the effect of four factors on participants' naturalness ratings of clefts and canonicals: (i) EXISTENCE (results from strength of existence as reported in pre-test 1), (ii) GRAMMATICAL FUNCTION, i.e. whether the focus was a subject or an object, (iii) AT-ISSUENESS, i.e. whether or not the element in A's speech commented on by B was at-issue and (iv) CONTRARINESS.

The motivation behind including AT-ISSUENESS as a factor comes from Destruel and Velleman (2014), who also argue for the relevance of *contrast in expectation* in the interpretation of clefts, and argue that two types of expectations may be at play; not just expectations about the state of the world but also expectations about the shape and direction of discourse. The latter type is directly relevant here since it may involve beliefs about the direction in which the discourse is going, expressed, among other ways, by marking content as at-issue or not-at-issue. We assume that interlocutors taking part in a discourse will generally address the propositions that are currently at-issue. Thus, a move which addresses a previously not-at-issue proposition is an *unexpected* discourse move. Consequently, if it-clefts are more natural when there is a conflict in expectations, we expect clefts to be judged more acceptable if Speaker B is commenting on content which had previously been marked as not-at-issue (in A's speech), thereby violating the expectation that such content will not need to be discussed further.

The factor CONTRARINESS was measured as follows: In non-contradictory contexts, items were attributed a contrariness value of 0, because Speaker B does not say anything that conflicts with what Speaker A says. In contradictory contexts, the contrariness value for an item is the strength of Speaker A's commitment to the conflicting proposition (as measured in pre-test 2). Thus, contrariness was operationalized as the product of commitment and contradiction, i.e. Contrariness $=$ Commitment $*$ Contradiction. If Hypothesis C turns out to be borne out, we expect that clefts will be judged as more natural in contexts where contrariness is higher.

Procedure: For this study, we counterbalanced the experimental dialogues across 12 lists so that each participant saw 24 items (12 subjects and 12 objects). The order of the items was pseudo-randomized among 24 fillers. A total of 64 participants were recruited on Amazon's Mechanical Turk and paid for their participation. On each trial, participants saw a written context (Speaker A's part), followed by Speaker B's sentence in either a cleft or a canonical form. Participants were asked to rate "How natural is Speaker B's sentence given A's" on a seven point Likert scale, with endpoints labeled as "extremely natural" and "extremely unnatural".

Results: We present results by sentence form, for clefts first, then for canonicals. Visual inspection of Figure 2 suggests that clefts were overall rated as more natural when the context contains a stronger degree of contrariness (as illustrated by the upward trend in the position of the red dots) than when the context does not include a contrast at all (blue dots). We analyzed the cleft data by fitting a series of mixed effect models predicting naturalness ratings from the fixed effects of interest and random effect structures that included random by-participant and by-item intercepts. Results were obtained using the *lme4* package (Bates et al., 2015) in R (R Core team 2016). We found no main effect of GRAMMATICAL FUNCTION (β = 0.376, SE =

0.114, t = 1.64), suggesting that whether the focus is a subject or an object, the naturalness ratings for the cleft are not influenced. Surprisingly, we also found no effect of AT-ISSUENESS (β = -0.518, SE = 0.113, t = -1.55); when clefts were used to signal an unexpected discourse move, i.e. to contrast with an element that was part of the non-at-issue content of A's speech, they were not drastically better than when commenting on an at-issue part of discourse.

There was, however, a main effect of EXISTENCE (β = 0.91, SE = 0.061, t = 14.8), suggesting that clefts are rated significantly better in contexts where the existence of the element to be contrasted is assumed, and an effect of CONTRARINESS (β = 0.383, SE = 0.022, t = 17.36), which supports Hypothesis C. Among models that contain subsets of these factors, the model that gave the best fit to the data was one that included both factors (i.e. Judgment $\sim$ Existence + Contrariness, χ^2 = 69.5, p $<$ .001)

Figure 3 combines the results for clefts and canonicals, with the lighter-colored dots representing the naturalness ratings of clefts (light red) and of canonicals (light blue) in the one experimental context where there is no contradiction present. Darker-colored dots represent the naturalness ratings for both sentence forms in other contexts, plotted by the strength of contrariness attributed to these contexts (i.e. commitment results from pre-test 1 * contradiction).

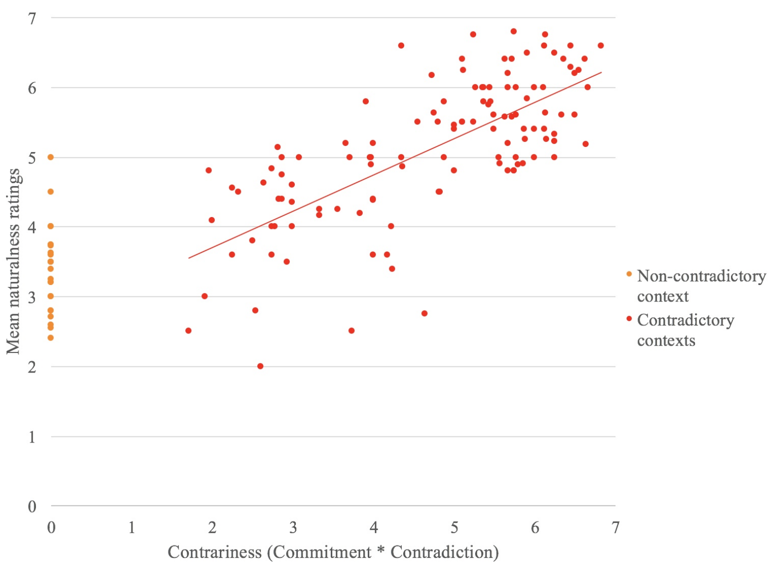

Figure 2: Mean naturalness ratings for clefts by ratings for contrariness.

Visual inspection of Figure 3 suggests that, for canonical sentences, the trend is quite different. As opposed to clefts, when the context does not include a contradiction, canonical sentences are rated as very natural. This should come to no surprise since, in English, canonical sentences constitute an unmarked sentence form, and are commonly used to answer an explicit wh-question. The trend for canonicals is also different from clefts when looking at contexts that *do* include a contradiction: the felicity of canonicals does not significantly improve as the level of contrariness increases, but in fact decreases. These observations are reflected in the results of our statistical analysis: Fitting a series of mixed-effect linear regression models to the

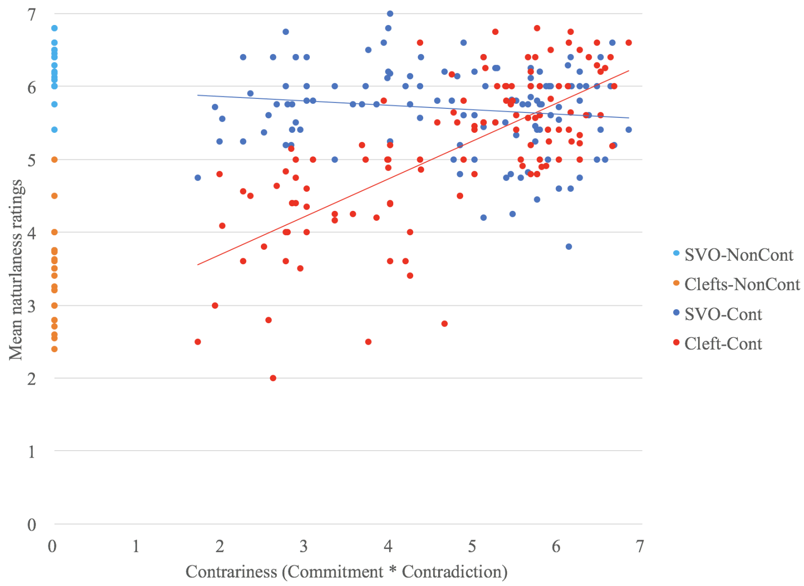

Figure 3: Mean naturalness ratings for canonicals vs. clefts by ratings for contrariness.

subset of data for canonicals only reveals a main effect of CONTRARINESS ($\beta = -0.092$, SE = 0.017, t = -5.24), but no effect of the other predictors (GRAMMATICAL FUNCTION, t= 1.43; AT-ISSUENESS, t= -1.28 and EXISTENCE, t= 1.19). Here, a model that includes both Existence and Contrariness does not give a better fit to the data than the two models with each single predictors (χ^2 = 1.39, p = 0.23; χ^2 = 2.75, p = 0.19, respectively).

One thing to note is that, in our experiment, sentences were delivered in written form, therefore without prosodic marking. It is possible that naturalness ratings could have been higher for contexts with a high level of contrariness if the stimuli had been heard with (the appropriate) pitch accent. Indeed, English commonly resorts to prosody to signal information structure, and contrastive focus is known to have a particular prosodic contour (Selkirk, 2002; Katz and Selkirk, 2011).

3. Closing Discussion

Our experimental results provide clear evidence in favor of the hypothesis that the felicity of clefts is related to the presence of *doxastic contrast* (Hypothesis C).

The goal of the present paper was to test prior hypotheses concerning clefts' standard components of meaning. We hypothesized that the mere presence of an antecedent in discourse which the clefted element would pick up and comment on (i.e. simple contrast) would not suffice to fully explain the felicity pattern of English it-clefts. Instead, we set out to test the hypothesis that something more refined is needed, namely a notion of contrast that includes a conflict between interlocutors' expectations. We followed Zimmermann's notion of constrast, which relates to how strongly the addressee believes the contrary, and experimentally operationalized it. So what have we learned?

We have shown that the presence of an explicit alternative—or in other words of a contrast, as defined in semantic terms by the previous literature (Rooth, 1992)—does increase the naturalness of clefts. This suggests that the presence of an antecedent is a necessary condition for clefts to be felicitous. But our study shows that it is not sufficient. Instead, we have shown that the factor which leads clefts to be significantly preferred (in contrast to canonicals and controlling for other factors known to influence the acceptability of clefts such as existence) is that of contrariness as defined along the lines of Zimmermann: Clefts are more natural when there exists a metalinguistic contrast. Additionally, we have seen that one type of expectation is most relevant for this metalinguistic contrast—expectations involving interlocutors' beliefs about the world (i.e. expectations about what content is likely to be added in the common-ground). On the other hand, our study showed that a conflict with respect to the direction in which the discourse is heading, operationalized as the conflicting element being (non)-at-issue, was not relevant, as this factor did not influence naturalness ratings. In sum, our main finding is that clefts are better not only when there is an antecedent to contradict in the preceding discourse context, but crucially when this antecedent is not the one expected by the listener. This result is not captured by any existing model of clefts.

Another interesting point concerns the felicity of canonical sentences, and their relation to clefts. Indeed, in many languages, clefts and canonicals are considered to be in competition in focus-related contexts. This means that, in theory, when canonicals are "bad", clefts take over as the preferred strategy and are more felicitous. Put slightly differently, clefts' emergence in discourse can depend on canonicals' availability and naturalness. But this is not the case in English. Indeed, our results do not show a complete reversal in trend, whereby canonicals become drastically unnatural in contexts where clefts increase in felicity. This is not surprising given that in English, focus (including contrastive focus) is typically marked via prosodic means. Thus, canonicals are never truly bad. Clefts simply represent an additional option the language has to signal a (even more) marked interpretation, e.g. doxastic contrast, unambiguously. On the other hand, in languages where canonicals are less (or not) available, like in French, we expect clefts to be judged more natural in non-contradictory contexts, but still expect an effect of contrariness on their felicity. We leave this as an issue to be investigated in future work.

Finally, the results of the present study have implications for current theories of focus. Much prior work on focus has emphasized properties that relate to the presence of some prior structure in discourse, for example the presence of a question, of an element of the same type as the target, or of a clause which exhibits structural parallelism. A quite different line of work was initiated by Pierrehumbert and Hirschberg (1990), who analyze various types of intonational contour in terms of speaker and hearer expectations. Our experiments and analysis imply that clefts have an intrinsically doxastic function. At the very least, this suggests that something like the Pierrehumbert and Hirschberg approach is the right one for analyzing the marking of information structure more generally. Our conclusion is that approaches which limit themselves to the occurrence or non-occurence of particular words or structures in a text are inherently insufficient to explain the distribution and interpretation of information-structural devices in English, and that a full theory of information structural marking must refer to doxastic notions such as the speaker's expectation as to what the hearer believes.

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An experimental investigation of (non-)exhaustivity in *es*-clefts[1]

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Abstract. We present an empirical study on exhaustivity inferences in German *es*-clefts compared to definite descriptions (pseudoclefts with an identity statement), exclusives, and focus constructions. Our study uses a novel mouse-driven picture-verification task in which the incremental updating of the context allows one to determine at which point participants take exhaustivity into consideration. Our results are compatible with a parallel analysis of clefts and definite pseudoclefts (see Percus 1997; Büring and Križ 2013; cf. DeVeaugh-Geiss et al. 2015), in so far as both structures are indeed interpreted on a par. In striking contrast to these analyses, however, we found that clefts do not systematically receive exhaustive interpretations, nor do definite pseudoclefts. We conclude that exhaustivity is not conventionally coded in either clefts nor definite pseudoclefts but rather arises through the anaphoric existence presupposition in both constructions together with a number-based implicature.

Keywords: *es*-clefts, definite pseudoclefts, exhaustivity, number-based pragmatic implicature, experimental study

1. Introduction

It has long been discussed in the literature that focus-background *it*-clefts (in German, *es*-clefts) give rise to both an existence as well as an exhaustivity inference, illustrated in (1). (For existence see Horn 1981; Delin 1992; Dryer 1996; Rooth 1999; Abrusán 2016; and for exhaustivity Halvorsen 1976, 1978; Atlas and Levinson 1981; Percus 1997; É. Kiss 1998; Velleman et al. 2012; Büring and Križ 2013, among others.)

(1) Es ist MAX, der einen Cocktail gemischt hat.
it is M. who a cocktail mixed has
'*It is* MAX *who mixed a cocktail.*' (it-*cleft*)
Max mixed a cocktail. (*canonical meaning*)
→ Someone mixed a cocktail. (*existence presupposition*)
→ No one except Max mixed a cocktail. (*exhaustivity inference*)

While there is general consensus that the existence inference is a presuppositon (although see the remarks in Büring and Križ 2013: Sec. 6 for arguments to the contrary), there is a longstanding debate on the semantic-pragmatic source of exhaustivity in clefts. On the one hand,

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there are accounts which take exhaustivity to be conventionally-coded and context-independent, which we will refer to as the semantic accounts. In this camp are: (a) the Definite-Semantic analyses that claim *it*-clefts share the presuppositional semantics of definite descriptions (Percus, 1997; Büring and Križ, 2013); and (b) the Inquiry-Terminating account, which takes clefts to encode the same discourse-semantic operators as exclusives, differing only in what is at-issue and what is not-at-issue (Velleman et al., 2012). On the other hand there are the non-conventionally-coded and context-dependent exhaustivity analyses, which we refer to as the pragmatic accounts, that take the exhaustive inference to be a generalized conversational implicature (Horn, 1981, 2014) or a focus-triggered scalar implicature (DeVeaugh-Geiss et al., 2015).[2]

One of the crucial ways in which the two camps differ is in the predictions regarding the robustness and systematicity of the exhaustive inference. With *robustness* we are referring to the strength of exhaustivity in terms of its obligatoriness and cancellability; by contrast, *systematicity* refers to the regularity of the exhaustive inference within and across both experimental settings and participants. In short, a robust inference is context-independent and non-negotiable, and a systematic inference will show up using various experimental methods and not just for a subset of the participants. Semantic analyses predict cleft exhaustivity will be robust and systematic; pragmatic analyses generally make the opposite prediction.

Another crucial way in which the theories differ is in their predictions in terms of *parallelism* with other exhaustivity effects, in particular for our study here, definite pseudoclefts. The definite semantic accounts of Percus 1997 and Büring and Križ 2013 make the clearest of all predictions in this respect, namely that clefts and definite pseudoclefts will pattern alike. The presuppositional account in Velleman et al. 2012, however, does not make any particular predictions regarding parallel behavior of clefts and definites. The pragmatic accounts, by contrast, predict clefts and definite pseudoclefts to elicit different response patterns, but plain focus and clefts may show comparable behavior.[3]

The goal of the two experimental studies presented here is to evaluate cleft exhaustivity along these three parameters, that is, robustness, systematicity, and parallelism. This paper will proceed as follows: In Section 2 we provide the theoretical and empirical background to cleft exhaustivity, and in Section 3 we describe the methods, design, and results of two joint experiments conducted on German *es*-clefts. Anticipating the results a bit, we find that clefts and definite pseudoclefts elicit nearly perfectly-parallel behavior, although neither showed robust nor systematic response patterns, results which no existing theory in the literature predict. In Section 4 we present two proposals which take advantage of the anaphoricity of clefts and definite pseudoclefts in order to account for the (non-)exhaustivity found in both constructions. Section 5 concludes.

[2] See, however, Pollard and Yasavul 2016 for the argument that clefts do not encode exhaustivity *per se*.

[3] However, see DeVeaugh-Geiss et al. 2015, in which clefts are predicted to show stronger exhaustivity effects than plain focus—even in subject position—given unambiguous focus-marking in the former but not in the latter. See also Horn 1981 for the claim that cleft exhaustivity is strengthened by the speaker going “out of her way” by using the cleft construction.

2. Background

Here we provide an overview of the theoretical and experimental work on cleft exhaustivity in the literature. We first take a closer look at the semantic approaches, which we divide into two groups: (a) the Definite-Semantic approaches, in particular Percus 1997 and Büring and Križ 2013, and (b) the Inquiry-Terminating (IT) approach, namely Velleman et al. 2012. Following this we discuss the pragmatic accounts in Horn 1981, 2014, and DeVeaugh-Geiss et al. 2015.

Theoretical approaches Starting with the semantic approaches, Percus (1997) proposed that *it*-clefts of the form *It is X who P* and definite descriptions of the form *The one who P is X* are parallel in their underlying syntax, with the former being derived from the latter syntactically through a process of extraposition (see Percus 1997 for details). Accordingly, the semantics for both constructions are claimed to be identical, with exhaustivity in clefts being equal to the uniqueness/maximality presupposition of the definite. Büring and Križ (2013), by contrast, make no claims regarding the syntax of the two constructions; rather, they employ algebraic semantics (Link, 1983) to model the exhaustivity effect for clefts as a homogeneity presupposition, which they argue accounts for the uniformity presupposition of definite descriptions as well. In this account, a cleft as in (1)—and the definite description counterpart—presupposes that Max is not one of a plurality of cocktail-mixers; i.e., either Max was the only cocktail-mixer, or he did not mix a cocktail at all. Since in both of these analyses cleft exhaustivity is conventionally-coded and context-independent, they make a clear and direct prediction that exhaustivity effects will be robust and systematic, with parallel behavior predicted for their definite description counterparts.

For the IT-construction approach, Velleman et al. (2012) make no particular claim about the parallelism between clefts and definites, instead taking clefts to share the same discourse-semantics with exclusives, namely by encoding the operators MIN and MAX. In particular, exhaustivity is encoded with MAX, which necessitates that no answer to the Current Question be above a certain upper bound. Thus, the answer terminates an inquiry by marking it as maximal. In exclusives MAX is at-issue, whereas in clefts it is not-at-issue. Similar to the semantic definite accounts, the IT-construction account would predict robust and systematic exhaustivity effects, given that the MAX operator is coded in the cleft-structure, but says nothing about parallel behavior between clefts and definites. Nevertheless, one problem with this approach—as pointed out by Pollard and Yasavul (2016)—is that clefts do not always provide a maximal answer, as illustrated in the following:

(2) Q: Who took the last cookie?
A: It was John or Mary, but I don't remember which.

Turning now to the pragmatic approaches, since exhaustivity in clefts does not appear to be as obligatory as semantic accounts might predict, Horn (1981) argued that exhaustivity in clefts is a (generalized conversational) implicature. This analysis is supported in part by data such as the following, in which—unlike the existence presupposition—the exhaustivity inference does not project out of the embedding environment, illustrated in (3).

(3) It isn't Max who mixed a cocktail.
  $\rightarrow$ Someone mixed a cocktail. (*existence*)
  $\nrightarrow$ No one except Max mixed a cocktail. (*exhaustivity*)

Furthermore, cleft exhaustivity appears to be easily violable, illustrated in (4).

(4) "Yes, it is bread we fight for—but we fight for roses too!"
(in a poem by James Oppenheim in 1911,[4] cited by Horn 2014)

Horn (1981, 2014) proposes that the exhaustivity inference in clefts has parallels to exhaustivity inferences in other focus constructions, which is argued to be strengthened for clefts by the fact that the speaker has chosen the more marked structure over the canonical word order. This additional strengthening is necessary to account for differences in acceptability for cancellation of plain focus and clefts, illustrated in the following contrast.

(5) a. Max has three children; indeed, he has four.
  b. #It was a pizza that Mary ate; indeed, it was a pizza and a calzone.
(examples (18c)–(18d), pg. 133, Horn, 1981)

Although DeVeaugh-Geiss et al. (2015) similarly argue exhaustivity is focus-derived, they take a different pragmatic approach from Horn 1981. In their analysis, clefts are a structural device for marking focus unambiguously, and exhaustivity is a focus-triggered scalar implicature derived from Grice's Maxim of Quantity: that is, "[t]he focal alternatives build scales, and the quantity maxim conversationally implicates the exclusion of alternatives higher on the scale" (DeVeaugh-Geiss et al., 2015: 387). The weaker exhaustivity for plain focus is argued to be due to focus projection, since projection to a higher constituent makes the focal alternatives ambiguous. By contrast, projection out of the cleft pivot appears not to be possible, and thus *it*-clefts provide optimal environments for further pragmatic enrichment. These pragmatic accounts both predict that exhaustivity in clefts is context-dependent and neither robust nor systematic; furthermore, there are no predicted parallels to definite descriptions. A summary of the semantic and pragmatic approaches to cleft exhaustivity and their predictions is found in Table 1. It is worth noting that there are no accounts which predict exhaustivity to be *–robust/systematic* and *+parallel* to definites.

	±robust/systematic	*±parallel definite descriptions*
(A) Semantic Definite	+	+
(B) Semantic IT-Construction	+	+/–
(C) Pragmatic Accounts	–	–
?	–	+

Table 1: Predictions of three theoretical approaches to cleft exhaustivity.

[4] `https://web.archive.org/web/20160216133611/https://en.wikipedia.org/wiki/Bread_and_Roses#Words`

Experimental work While the theoretical literature tends to bias toward semantic accounts of cleft exhaustivity, experimental work rather supports a pragmatic account, since cleft exhaustivity has been shown to be less robust and less systematic than would be predicted for an inference which is conventionally-coded and context-independent. Prior studies have typically taken exhaustivity in exclusives as a baseline comparison for cleft exhaustivity. One such example is Onea and Beaver (2009), who tested exhaustivity effects in Hungarian preverbal focus using the "*Yes, but…*" test, and the subsequent studies on clefts by Destruel et al. (2015). In this paradigm, participants are presented with question-answer pairs in which, given a visual stimulus with or without an exhaustivity violation, they had to choose between three possible continuations corresponding to different exhaustivity strengths: (i) strictly exhaustive (*No. …*), (ii) slightly exhaustive (*Yes, but…*), and (iii) non-exhaustive (*Yes, and…*). While exclusives elicited a majority of strictly exhaustive responses (i) in contexts depicting an exhaustivity violation, clefts in English and French elicited a majority of slightly exhaustive (ii) and non-exhaustive (iii) responses. Destruel et al. (2015) argue that the *Yes, but …* paradigm is a test of the at-issue status of an inference, and given their results, that exhaustivity in clefts is not-at-issue while in exclusives it is at-issue.

However, not-at-issue inferences can have either a semantic or a pragmatic source (Horn, 2014). One diagnostic for the source of an inference traditionally found in the literature is to test whether or not an inference is defeasible: whereas semantic inferences are truth-conditional and cannot be cancelled in unembedded environments,[5] pragmatic inferences are non-truth-conditional and thus typically more easily cancellable, as illustrated in (5a). The cancellation diagnostic is the basis for the experimental studies in Saur 2013 and DeVeaugh-Geiss et al. 2015 on German *es*-clefts. In both studies, the exhaustivity inference from a cleft was followed by a violation (e.g., *Es ist X, der P. Außerdem, Y P.* 'It was X that P. Furthermore, Y P,' Saur 2013). In comparison to exclusives, clefts showed weaker exhaustivity effects when the exhaustive inference was violated: that is, participants more readily accepted cleft sentences despite the violation, which was not the case for sentences with *nur* 'only.' Based on the relative acceptability found in both studies, exhaustivity is argued not to be conventionally coded in clefts, but rather derived as a pragmatic implicature.

Although most studies on exhaustivity compare clefts directly to exclusives, not all have. One such study is Byram-Washburn et al. 2013, in which the acceptability of clefts was tested using written dialogues across various conditions. They find that conditions with violations of contrastiveness led to much lower acceptability ratings than conditions with violations of exhaustivity (see also Destruel and Velleman 2014 for experimental studies on contrastiveness inferences in clefts). Based on these findings, they conclude that exhaustivity is not conventionally-coded but a conversational implicature (in line with Horn 1981). However, it is not clear that the target stimuli were in fact violating exhaustivity, since there is a possible domain narrowing given the temporal adverb *yesterday* found in the target but not in the context. A direct comparison to exclusives could have, in fact, served as a useful control.

[5]Compare to embedded environments, in which semantic inferences, i.e., assertions and presuppositions, are (potentially) interpreted under the embedding operator, and thus cancellable; for presupposition cancellation, see, e.g., Karttunen 1971; Stalnaker 1974; Chierchia and McConnell-Ginet 1996; Abbott 2006; Abrusán 2016, among others.

To sum up, the experimental literature has found that the at-issue status of cleft exhaustivity is different from that of exclusives, with exhaustivity in clefts being not-at-issue and that of exclusives at-issue (in line with previous claims in the theoretical literature, e.g., Horn 1981). Moreover, the results from a growing number of studies are more compatible with a pragmatic approach than a hardwired semantic approach to cleft exhaustivity, given that exhaustivity violations are generally found to be more acceptable for clefts than might be expected for a context-independent and truth-conditional inference. Cancellation of exhaustivity is nonetheless not as acceptable as might be expected for a pragmatic analysis (DeVeaugh-Geiss et al., 2015), and no study to date—as far as the authors are aware of—have directly compared cleft exhaustivity to the maximality inference of definite descriptions, a notable gap between the theoretical and experimental literature.

3. Methods & results

We conducted two joint-studies on German *es*-clefts in order to test the robustness, systematicity, and parallelism of cleft exhaustivity when compared to exclusives, focus, and definite pseudoclefts using a mouse-guided incremental information paradigm written in Python (GNU/Linux v.3.4.2; Windows v.3.3.5) with the PyGame module (v.1.9.2a0, LGPL, Shinners 2011). Participants were presented with contextual information one box at a time in order to measure which truth-value judgment was made ('true' or 'false') as well as at which point there was enough information for participants to make their judgment. The design of both experiments was the same and will be presented together here.

At the beginning of the experiment participants were introduced to four roommates, Jens, Max, Tom, and Ben, who they were told undertook various activities together. Participants were informed that only these four roommates would appear throughout the entire experiment. After a brief introduction to the experiment including three practice trials, the experiment started. At the beginning of each trial, participants heard the audio stimuli in their headphones, after which they uncovered up to four boxes revealing the various activities of the four roommates. Their task was to uncover only as many boxes as necessary to make a judgment whether the sentence they heard was true or false. An example of the four target auditory stimuli is presented in (6)–(9). Pitch accent was always on the subject, illustrated by capital letters in the example stimulus.

(6) EXCLUSIVE

Nur	MAX	hat	einen	Cocktail	gemischt.
only	M.	has	a	cocktail	mixed.

'*Only Max mixed a cocktail.*'

(7) PLAIN FOCUS

MAX	hat	einen	Cocktail	gemischt.
M.	has	a	cocktail	mixed

'*Max mixed a cocktail.*'

(8) DEFINITE PSEUDOCLEFT

Derjenige, der einen Cocktail gemischt hat, ist MAX.
the.one who a cocktail mixed has is M.
'*The one who mixed a cocktail is Max.*'

(9) CLEFT

Es ist MAX, der einen Cocktail gemischt hat.
it is M. who a cocktail mixed has
'*It is Max that mixed a cocktail.*'

Note that in the definite pseudocleft sentences, the complex definite forms *derjenige*, *diejenige*, and *dasjenige* are compounds of the singular determiner elements *der*- 'the.MASC,' *die*- 'the. FEM,' or *das*- 'the.NEUT' plus *-jenige*, the latter derived etymologically from the demonstrative marker *jene/jener/jenes* meaning 'that one (over there).' We will argue that this inherent deictic or context-anaphoric meaning component will prove to be crucial for the interpretation of definite pseudoclefts in our experiments. For all stimuli in the definite pseudocleft condition, the complex-definite subject was singular and masculine, and it displayed singular nominative marking and gender agreement with the masculine proper name in predicative position.

The boxes were manipulated to present information in such a way as to be informative about the source and status of the exhaustivity inference. That is, whereas Box 1 was always irrelevant to the purposes of the experiments, the two experiments differed in a critical way at Box 2.

- Experiment I tested the at-issue status of exhaustivity by verifying in Box 2 the canonical meaning or prejacent of the target sentences. For example, for sentences (6)–(9) Max says: '*I mixed a cocktail.*' If exhaustivity is at-issue, we predict that after revealing the second box participants must continue uncovering Box 3 and Box 4 in order to check that exhaustivity holds.

- Experiment II tested the semantic-pragmatic source by falsifying exhaustivity in Box 2. For example, for sentences (6)–(9) someone other than Max, e.g., Ben, says: '*I mixed a cocktail.*' We predict that if exhaustivity is semantic (asserted or presupposed), falsifying exhaustivity should be enough to judge the target sentence as false; by contrast, if it is pragmatic the exhaustivity implicature is defeasible and thus participants can continue to uncover Box 3 and Box 4 in order to check the as-yet-unverified prejacent.

Although participants were free to choose which box to uncover next, we programmed the experiment such that the order was pre-determined. Moreover, once inside a box the cursor could not exit the box for at least 2000ms. This was done to keep participants from unnecessarily uncovering too many boxes, such as, e.g., by automatically mousing over all four boxes and then making a judgment. Further details of the individual experiments will be presented below.

Our experiments exhibit the following important design features that will allow for a controlled and systematic study of exhaustivity inferences in clefts and definite pseudoclefts.

1. The experiments explicitly control for at-issue semantic exhaustivity triggered by exclusive particles, on the one hand, and for bona fide pragmatic exhaustivity, as triggered by instances of in situ prosodic focus in auditory stimuli.
2. The experiments explicitly control for domain restriction in order to rule out any attempts at explaining exhaustivity violations away in terms of a subsequent enlargement of the quantificational domain.
3. The experiments involve no scalar ordering of alternatives in order to rule out attempts at explaining exhaustivity effects away by recourse to ordering on a contextually-supplied scale.

In both experiments there were two dependent variables: *Early Judgment* and *Late Judgment*. The first dependent variable was measured at Box 2 and had three values: *richtig* 'correct,' *falsch* 'false,' or 'continue' by uncovering Box 3. The second dependent variable was the final evaluation of the stimuli once all relevant information at the third or fourth box had been revealed. Clearly there was data for the *Late Judgment* only when participants chose to continue in the *Early Judgment* measure.

There was a 1:1 target-to-filler ratio. Filler items consisted of sentences with universal quantifiers (*jeder* 'everyone'), expletive constructions (*es ist klar, dass* ... 'it is clear that ... '), plural conjunctions (e.g., *Ben und Max haben* ... 'Ben and Max have ... '), and scalar constructions (*weniger als drei Leute* 'fewer than three people'). There were 32 target items and 32 filler items for a total of 64 sentences.

For Experiment I, we tested 32 German native speakers (24 female, 8 male), all students in Potsdam and Berlin, Germany (average age: 25.6).[6] For Experiment II we tested 32 German native speakers (20 female, 12 male), most of them students in Göttingen, Germany (average age: 27.8). The experiments took part in a laboratory environment, and participants were compensated for their time. We now turn to the individual experiments and their results.

Factorial design of Experiment I Experiment I involved a 4*2 factorial design, the two factors being *Sentence Type* (EXCLUSIVE, FOCUS, DEFINITE PSEUDOCLEFT, CLEFT) and *Exhaustivity* (±EXHAUSTIVE). Recall that the early judgment was at Box 2, which verified the canonical meaning or prejacent, whereas the factor *Exhaustivity* was measured as a late judgment in Box 3 and Box 4. For the condition +EXHAUSTIVE, exhaustivity holds. For instance, given a target sentence as in (6)–(9), in Box 2 Max says he mixed a cocktail, and in the other boxes none of the remaining roommates had the property of mixing a cocktail, as illustrated below. For the condition –EXHAUSTIVE, by contrast, one of the roommates in Box 3 or Box 4 also has the relevant property. For example, in Box 3 Jens says 'I mixed a cocktail,' which, for the sake of space, is not illustrated here.

BOX 1:	Tom	'*I fetched a straw.*'	BOX 3:	Jens	'*I opened a bottle.*'
BOX 2:	**Max**	'***I mixed a cocktail.***'	BOX 4:	Ben	'*I provided a schnaps.*'

[6]There were 33 participants in Experiment I, but one participant was removed since judgments were erratic on the controls.

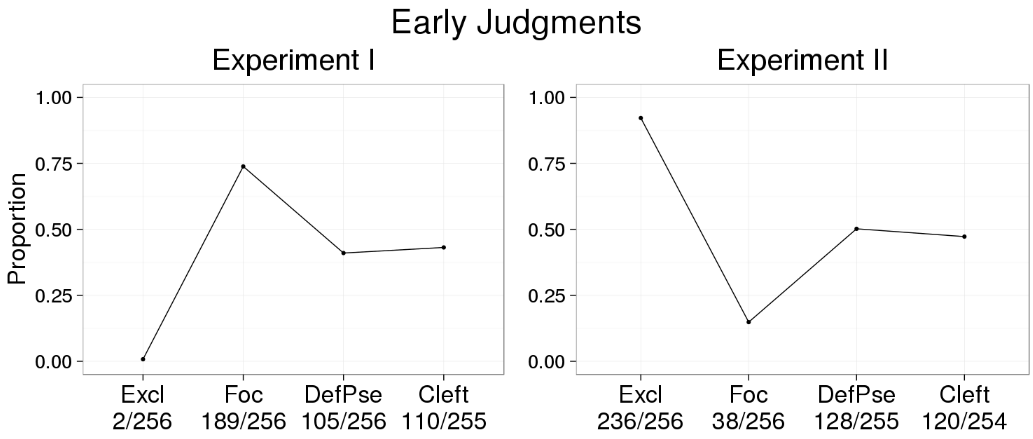

Figure 1: Proportion of early judgments (judgment = 1, continue = 0) for Experiment I (left) and Experiment II (right).

Experiment I results For data preparation of the target items, 1 response out of the 1024 potential responses at Box 1 was treated as an error and removed. All data at Box 2 were coded with 1 for judgment made and 0 for continue. Note that in Experiment I when a participant made a judgment at Box 2, the sentence was always judged 'correct'; that is, no participant selected 'false' at this point. Exclusives elicited a judgment at Box 2 only 1% of the time (2/256 responses): most participants chose to continue uncovering Boxes 3 and 4, as expected. By contrast, clefts and definite descriptions elicited a 'correct' judgment 43% (110/255 responses and 41% of the time (105/256 responses), respectively, and focus 74% of the time (189/256 responses). See the left graph in Figure 1 for the proportion of judgments made per sentence type in Experiment I. Note that when participants continued and exhaustivity was violated in Box 3 or Box 4, the sentence was consistently judged 'false,' suggesting that the experiment was indeed sensitive to exhaustivity.

We conducted a generalized linear mixed effects model (binomial family) in R with the dependent variable being the early response at Box 2 and the independent variable the sentence type (i.e., *glmer(Judgment.Box2 ~ SentType + (1|Item) + (1|Participant), family = binomial, data = ExpI)*).[7] Contrast coding was non-orthogonal: clefts were the baseline comparison for each of the other sentence types. There was no significant difference found between clefts and definite descriptions (SE = 0.286, p = 0.392); by contrast, there was a highly significant difference found between clefts and exclusives, and clefts and focus ($p < 0.001$ in all cases).

Factorial design of Experiment II Experiment II again had a 4*2 factorial design, as in Experiment I, the two factors being *Sentence Type* (EXCLUSIVE, FOCUS, DEFINITE PSEUDO-CLEFT, CLEFT) and *Canonical* (±CANONICAL). Recall that the early response was at Box 2, which falsified the exhaustive inference. The factor *Canonical* was measured as a late response in Box 3 and Box 4. The condition +CANONICAL means the canonical meaning or prejacent holds. For instance, for the sentences in (6)–(9) Max says in Box 3 that he in fact mixed a

[7] We ignore the late response in our computation, because in this early stage of evaluation it plays no role.

cocktail, as illustrated below. For the condition –CANONICAL, by contrast, Max in Box 3 or Box 4 says he did something other than mix a cocktail. For example, in Box 3 Max says 'I provided a schnaps,' which, for the sake of space, is not illustrated here.

BOX 1:	Jens	'*I opened a bottle.*'	BOX 3:	Max	'*I mixed a cocktail.*'
BOX 2:	**Ben**	'***I mixed a cocktail.***'	BOX 4:	Tom	'*I fetched a straw.*'

Experiment II results For data preparation of the target items, there were 3/1024 'correct' judgments for the falsifier at Box 2, which were treated as errors. The remaining data at Box 2 were coded with 1 for judgment made and 0 for continue. As predicted, exclusives elicited 'false' judgments 92% of the time (236/256 responses): most participants chose not to continue uncovering contextual information, even though the prejacent had not yet been verified. By contrast, focus elicited judgments only 15% of the time (38/256 responses): that is, most participants continued to uncover the remaining boxes to see if the canonical meaning held. Definite descriptions elicited 'false' judgments 50% of the time (128/255 responses), and clefts were similar in eliciting judgments 47% of the time (120/254 responses). Note that for participants who continued uncovering and found that the prejacent did not hold, they consistently judged the sentence as 'false'; furthermore, when they found that the prejacent was verified, they consistently judged the sentence as 'true.' See the right graph in Figure 1 (on page 355) for the proportion of judgments made per sentence type for Experiment II.

Again, we conducted a generalized linear mixed effects model in R with the dependent variable being the early response at Box 2 and the independent variable the sentence type (i.e., *glmer(Judgment.Box2 ~ SentType + (1|Item) + (1|Participant), family = binomial, data = ExpII)*). Contrast coding was non-orthogonal: clefts were the baseline comparison for each of the other sentence types. Again, there was no significant difference found between clefts and definite descriptions (SE = 0.2223, p = 0.403). By contrast, there was a highly significant difference found between clefts and exclusives, and clefts and focus ($p < 0.001$ in all cases).

Post hoc analysis In both experiments we measured whether and at which point participants made a truth-value judgment given the incremental evidence provided. Crucially, we were interested in participant response behavior at Box 2, which differed between the two experiments: in Experiment I the exhaustive inference was verified at Box 2, whereas in Experiment II the exhaustive inference was falsified at Box 2. The questions associated with the early evaluation variable are as follows. In Experiment I we established whether verifying at Box 2 that the canonical meaning holds was sufficient to make a judgment, or whether the exhaustivity inference was taken into consideration by further uncovering Boxes 3 and 4. That is, if a participant judged the sentence they heard as 'true' upon revealing the information at Box 2, exhaustivity did not matter (enough) to justify further investigation. By contrast, if a participant continued this means that exhaustivity was significant enough to warrant checking the upcoming information. In this case we predict participants will judge the sentence as 'true' in the +EXHAUSTIVE late response condition and 'false' in the –EXHAUSTIVE late response condition. This is precisely what we found, confirming that participants understood the logic of the experiment.

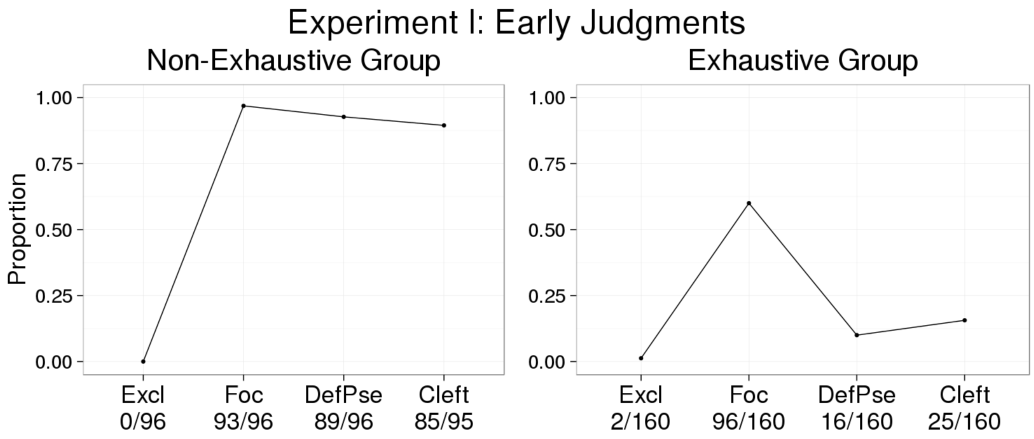

Figure 2: Proportion of early judgments (judgment = 1, continue = 0) for Experiment I for non-exhaustive group (left) and exhaustive group (right).

When analyzing participant behavior individually we found two main groups for definite pseudoclefts and clefts: either participants treated definite pseudoclefts and clefts as exhaustively as exclusives (Exp. I: 20 participants; Exp. II: 16 participants) or as non-exhaustively as focus (Exp. I: 12 participants; Exp. II: 16 participants). These categories were calculated like so: In Experiment I, if they chose 'continue' for definite pseudoclefts 5/8 or more times they fell into the exhaustive interpretation group, since exhaustivity was significant enough to warrant further uncovering a majority of the time; otherwise, they were in the non-exhaustive interpretation group (i.e., 4/8 or less times they chose 'correct' when the canonical meaning of the sentence was verified without checking the remaining boxes). In Experiment II, if they made a 'false' judgment for definite pseudoclefts 5/8 or more times they again fell into the exhaustive interpretation group, since falsifying exhaustivity at Box 2 was enough to judge the auditory stimuli as false; otherwise, they were in the non-exhaustive interpretation group (i.e., 4/8 or less times they chose 'continue' to check that the canonical meaning holds despite exhaustivity having been falsified).

Again, the post hoc analysis, illustrated in Figure 2 for Experiment I (on this page) and Figure 3 for Experiment II (on page 358), shows quite clearly that definite pseudoclefts were indeed interpreted in full parallel to clefts in both the participant groups as well as in the experiments, albeit in two different ways, either entirely exhaustively or entirely non-exhaustively. It is therefore reasonable to assume that the source of the exhaustivity inference is identical, or at least very similar, in both clefts and definite pseudoclefts.

4. Analysis

The experimental data are not in line with any of the major theories of cleft exhaustivity. As pointed out in connection with Table 1 on page 350, neither semantic nor pragmatic analyses would predict exhaustivity in clefts to be non-robust/unsystematic and parallel to definite pseudoclefts at the same time. The post-hoc analysis in particular indicated that our results are incompatible with semantic analyses of cleft exhaustivity (the effect being non-robust and unsystematic across speakers and experiments). Finally, it seems unlikely that the existence of

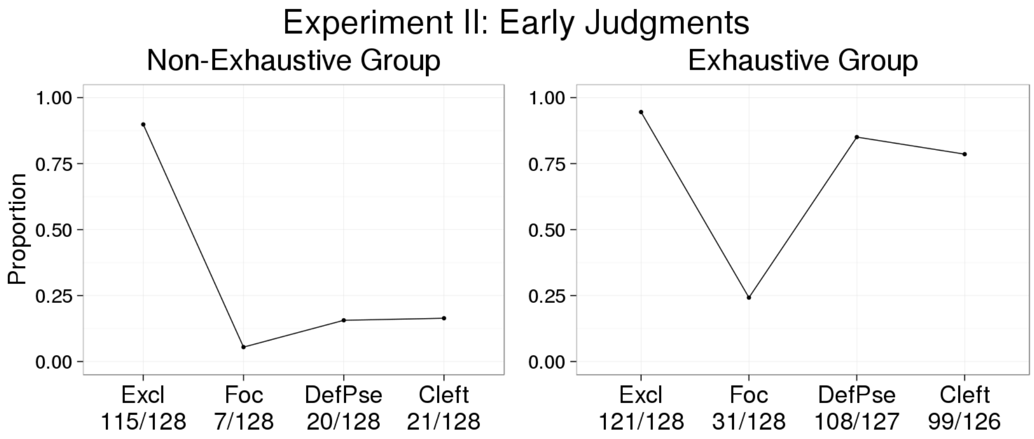

Figure 3: Proportion of early judgments (judgment = 1, continue = 0) for Experiment II for non-exhaustive group (left) and exhaustive group (right).

(unambiguously) marked focal alternatives is responsible for triggering the pragmatic exhaustivity implicature, given that there is weak exhaustivity in the plain focus condtions. In light of all this, we propose an alternative pragmatic analysis of the exhaustivity effect in clefts and definite pseudoclefts. In particular, we argue that our participants systematically differed in their assumptions regarding the potential linguistic contexts required for licensing the critical audio stimulus, in particular its existence presupposition.

Anaphoric presupposition of clefts It is standardly assumed in the literature that clefts have anaphoric potential (Prince 1978; Horn 1981; Soames 1989; Delin 1992; Hedberg 2000; and many others). They introduce as part of their constructional meaning a presupposition that marks the information conveyed by the cleft as known-fact (Prince, 1978) or, simply, as anaphoric (Delin, 1992). The anaphoric potential of clefts can be formally expressed in the form of an existence presupposition, following van der Sandt 1989 and Rooth 1996.

Turning next to the experimental setting of our experiments, there is no linguistic context against which to evaluate the audio stimulus. As a result, the existential presupposition of the cleft condition must be accommodated. This amounts to saying that the hearer will integrate into her discourse model some discourse referent with the relevant property described by the cleft relative that she takes the experimental speaker to (anaphorically) refer to. Crucially, we do not adopt claims in Szabolcsi 1994 (on pre-verbal focus in Hungarian) and Percus 1997 (on English *it*-clefts) that the existential presupposition of cleft sentences comes with an obligatory maximality effect. Instead we propose that part of what the experiment participants did was to reason about the anaphoric antecedent of the existential presupposition. On this proposal, the exhaustive group would take the presupposed discourse referent x to refer to an accommodated maximal discourse referent with property P denoted by the cleft relative.

One way of constructing a suitable discourse referent x would consist in assuming the denotation of an implicit question, as provided in Pollard and Yasavul 2016. That is, participants could have assumed that the cleft addresses the issue "who P?," thus resolving the existence presupposition to a maximal discourse referent x with property P. Linking this with an identificational at-issue semantics for clefts, namely x = Pivot, the result will be that the maximal individual x with property P equals the pivot, which comes down to an exhaustivity claim. By contrast, the non-exhaustive group would accommodate a non-maximal discourse referent, as suggested by Pollard and Yasavul 2016 for indefinite antecedents. For this group the interpretation is then simply that there is some x with property P, and x = Pivot, which does not trigger an exhaustivity inference.

The foregoing assumptions would, in principle, suffice in order to explain our experimental findings in terms of differences in the way in which the experimental subjects accommodated the anaphoric existence presupposition of clefts. On this analysis, the exhaustivity inference is a pragmatic effect that can be reliably predicted in a number of explicit contexts, but which leads to ambiguity in the absence of overt linguistic context. Still, an analysis along these lines is not without problems. A potential issue is that the proposed analysis relies explicitly on an identificational, as opposed to, e.g., a predicational, semantic analysis of clefts, working in tandem with the presupposed anaphoric content.

Nevertheless, we do not want to dismiss the above sketch of an analysis altogether. At present, though, our experimental data do not provide sufficient and conclusive evidence in favor of this particular spell-out. Fortunately, there is no need for basing the pragmatic analysis of cleft exhaustivity on the semantic assumption that clefts are identificational. In particular, there is an additional implicature giving rise to exhaustivity even on a predicational semantics for clefts. This second implicature interacts with the existence presupposition and is triggered by the choice between singular and plural clefts. The fact that German clefts show consistent and transparent semantic marking of number is assumed to make the effect even stronger.

Number implicature of German clefts As discussed in Büring and Križ 2013, there are plural and singular clefts, as shown in (10).

(10) a. Es waren Georg und Friedrich, die Wilhelm verprügelt haben.
it COP.**PL** Georg and Friedrich REL.MASC.**PL** Wilhelm beaten have
'*It was George and Frederick that beat William.*'

b. Es war Georg, der Wilhelm und Friedrich verprügelt hat.
it COP.**SG** Georg REL.MASC.**SG** Wilhelm and Friedrich beaten has
'*It was George that beat William and Frederick.*'

It is reasonable to assume that the presupposed discourse referent inherits the singular or plural feature from the cleft sentence. Put differently, plural clefts presuppose the existence of a non-atomic sum-individual, while singular clefts at least give rise to the implicature that the anaphoric antecedent is not a sum individual, but rather an atomic individual.

Especially in situations with zero context, as found in our experiments, we expect this implicature to give rise to an exhaustivity inference along the following lines of reasoning: By using the singular cleft, the experimental speaker implicates that there is no sum-individual antecedent with the cleft relative property P. If there actually were sum-individuals with the cleft relative property P, and the speaker were aware of that fact, the listener would be in no position to identify the singular discourse referent the speaker meant to refer to, given the absence of further linguistic context. This in turn would make it impossible to assign the cleft sentence a proper interpretation, as it remains unclear which individual the cleft sentence is about. Hence, being cooperative, the speaker must have meant to convey that there are no potential plural antecedents at all. Hence, we are safe to assume that there is exactly one individual with property P in the context, which is then identified by the pivot. The core ingredients of the number-based analysis are summed up in (11):

(11) Components of number-based pragmatic analysis of cleft exhaustivity:
  a. Asserted content: $P(focus)$ or $focus = x$
  b. Existence presupposition: $\exists x[P(x)]$, $atomic(x)$
  c. Singular-based implicature: $\neg\exists Y[sum(Y) \wedge P(Y)]$

Note that participants have the option to reason that the speaker is not committed to exhaustivity to a degree that is sufficient to judge the cleft sentence as true or false based on the truth or falsity of this implicature. This can happen, for instance, if a speaker has no relevant knowledge concerning the other individuals under consideration, thereby restricting the scope of the existence presupposition to the singular individual she is certain about. This explains the behavior of the non-exhaustive group.

We would like to stress that the analysis sketched in the previous subsection and the number-based analysis presented here are by no means mutually exclusive. It may very well be possible that both interpretive processes are simultaneously active: The number-contrast would create an exhaustivity implicature based on the anaphoric existential presupposition plus some reasoning over the speaker's intention in choosing a singular over a plural cleft. And, additionally, it would also be possible to maximize the anaphoric antecedent.

Definite pseudoclefts What remains to be done is to show how the pragmatic analysis developed for clefts can be extended in order to capture the parallel interpretive properties of definite pseudoclefts in our experiments. Following a long list of scholars ranging from Frege (1892) to Coppock and Beaver (2015), definite descriptions in general are commonly treated as triggering a uniqueness presupposition. However, at least for the particular definite expressions found in definite pseudoclefts in German, we argue that deriving exhaustivity in an anaphoric familiarity-based analysis à la Heim 1982 better captures the results reported here.

We argue that definite pseudoclefts in German cannot be analyzed as run of the mill definite descriptions, given our experimental findings. Instead, we would like to propose that definite pseudoclefts express anaphoric reference as part of their conventional meaning, as evidenced by their discourse-semantic behavior and by their morpholexical make-up. First, note that the form *-jenige* shows the weak inflectional properties of prenominal modifying elements in definite contexts, but, more importantly, as a deictic expression it must anaphorically relate to a salient discourse referent in the preceding context (or at least to a perceptually salient individual in the utterance situation). We therefore propose that the strong bias for interpreting definite pseudoclefts as anaphoric expressions, rather than as referentially unique expressions, follows from the explicit presence of the demonstrative (anaphoric) element as part of the complex definite determiner.

Second, observe that definite peudoclefts are deviant as discourse openers, especially in comparison to their plain definite description counterparts, even if the two types of definite expressions have the same descriptive content. The relevant contrast is illustrated in (12). Example (12b) allows for easy accommodation of the fact that the lord, whoever that may be, has been murdered by someone, thereby triggering the interpretation that the gardener was the murderer. Example (12a), in contrast, resists such an interpretation. The most natural interpretation for (12a) is that it presupposes that the murder of the lord has already been the topic of discussion in the preceding discourse, either explicitly or implicitly. This being a condition on discourse structure, and not on the external world as such, it is very hard to accommodate, especially at the beginning of a story.

(12) Out Of The Blue
  a. #Derjenige, der den Lord umgebracht hat, war der Gärtner.
     the.one who the lord murdered has was the gardener
     '*The one who murdered the lord was the gardener.*'
  b. Der Mörder des Lords war der Gärtner.
     '*The murderer of the lord was the gardener.*'

Having established that definite pseudoclefts express an anaphoric relationship in the form of an existence presupposition rather than uniqueness in the utterance situation, we can apply the same reasoning as for the cleft-case, which gives us precisely the same predictions: With uniqueness no longer part of the semantic meaning of the definite pseudocleft expressions, we do not expect systematic or robust uniqueness or exhaustivity effects to show up with this construction. Furthermore, the singular-plural contrast is also observed with definite pseudoclefts, although oddly only in the masculine and feminine paradigm. The masculine and feminine forms *derjenige* and *diejenige* are morphosyntactically and semantically marked for singular, as opposed to their plural counterpart *die-jenigen* 'the.PL-ones.' This accounts for the parallel behavior of clefts and definite pseudoclefts in our experiments. Since we only referred to masculine referents in the experiments, the use of the singular form of the definite pseudocleft should give rise to the same number-based pragmatic reasoning procedure as laid out for the case of clefts above.

By contrast, the neuter form *dasjenige* resembles the neuter determiner/relative form *das* 'the/ which' and the neuter *wh*-expression *was* 'what' in being semantically number-neutral (Zimmermann, 2011; Bayer, 2002). As a result, the neuter forms can refer to singular and plural forms alike, as illustrated in (13a), unlike their masculine and feminine counterparts, as in (13b):

(13) a. Dasjenige, was Peter gekauft hat, ist Brot und Rosen.
     DEF.**NEUT** WH.**NEUT** Peter bought has COP.**SG** [bread and roses]$_{\mathbf{PL}}$
     '*What Peter bought is bread and roses.*'

b. *Derjenige, den Peter eingeladen hat, ist Klaus und Peter.
DEF.MASC.**SG** REL.MASC.**SG** Peter invited has COP.**SG** [Klaus and Peter]$_{\mathbf{PL}}$
(lit.) '*The one that Peter invited is Klaus and Peter.*'

The difference between masculine/feminine and neuter forms in terms of semantic number marking gives rise to another interesting prediction to be checked in future research: If the number-based pragmatic analysis of pseudoclefts is on the right track, we predict neuter definite pseudoclefts in German to be less exhaustive than their masculine or feminine counterparts. Given that the neuter singular form can refer to both singularities and sum individuals, there is no comparable contrast in the semantic number paradigm, and singular-based implicatures should be much weaker, or altogether absent.

5. Conclusion

We reported the results of two offline experiments on cleft exhaustivity in the incremental information-retrieval paradigm. It was shown that clefts and definite pseudoclefts are treated on a par by the participants of a verification and a falsification experiment, in contrast to sentences with plain intonation foci and to sentences with exclusive particles. In particular, the exhaustivity inference in clefts and definite pseudoclefts is more pronounced than with plain focus, while being less systematic and less robust than with exclusive particles. We have argued that the non-systematic and non-robust nature of the exhaustivity effect is not accounted for by existing theoretical accounts, be they semantic or pragmatic. Moreover, a post hoc analysis further unveiled that about half of the participants treated both clefts and pseudoclefts systematically as exhaustive, while the other half treated both as non-exhaustive. Again, this finding poses a challenge to semantic theories of cleft exhaustivity.

In response to the novel data, we argue that there must be some pragmatic component in the derivation of cleft exhaustivity. We then sketched a pragmatic analysis of cleft exhaustivity in clefts and definite pseudoclefts, which is based on two central assumptions: Both sentence types are anaphoric and introduce an existence presupposition. The choice of singular or plural in clefts and definite pseudoclefts triggers a pragmatic implicature, which is further supported by a systematic contrast in the marking of semantic singular and plural in German. The proposed analysis makes a number of interesting predictions to be investigated in future research, such as crosslinguistic differences or the special case of neuter definite pseudoclefts in German. At the same time, in its present form the proposed analysis is only a sketch, and more theoretical, experimental, and crosslinguistic work needs to be done before a fully detailed compositional analysis of exhaustivity in clefts and definite pseudoclefts is in reach.

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A. Appendix: Target auditory stimuli

Target auditory stimuli in German for narrow focus condition. In order to recreate the cleft, definite pseudocleft, and exclusive conditions, follow the examples in (6)–(9) on pages 352–3.

1. Tom hat einen Pullover angezogen.
2. Max hat einen Cocktail gemischt.
3. Jens hat einen Reifen gewechselt.
4. Ben hat einen Koffer gepackt.
5. Jens hat einen Flyer gedruckt.
6. Ben hat eine Katze gestreichelt.
7. Tom hat ein Hemd gebügelt.
8. Max hat ein Gedicht aufgesagt.
9. Jens hat einen Teppich gekauft.
10. Ben hat einen Kuchen gebacken.
11. Tom hat einen Kinderwagen geschoben.
12. Max hat einen Kaktus gepflanzt.
13. Tom hat eine Ziege gefüttert.
14. Max hat eine Schürze genäht.
15. Jens hat ein Regal getragen.
16. Ben hat ein Märchen erzählt.
17. Tom hat einen Weihnachtsbaum geschmückt.
18. Max hat einen Brief geschrieben.
19. Jens hat einen Ball geworfen.
20. Ben hat einen Berg bestiegen.
21. Jens hat eine DVD eingelegt.
22. Ben hat eine Orange ausgepresst.
23. Tom hat ein Steak gebraten.
24. Max hat ein Zimmer aufgeräumt.
25. Jens hat eine Karte gebastelt.
26. Ben hat einen Ofen befeuert.
27. Tom hat einen Tumor entfernt.
28. Max hat einen Fleischspieß gegrillt.
29. Tom hat eine Rechnung bezahlt.
30. Max hat eine Salbe aufgetragen.
31. Jens hat ein Loch gebohrt.
32. Ben hat ein Schwein beobachtet.

Cognitive vs. emotive factives: An experimental differentiation[1]

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Abstract. A central question in current presupposition theory is what (sub-)classes of triggers there are and how they differ from one another (Abusch 2002; Sudo 2012; Tonhauser et al. 2013; Romoli 2012; Abrusán 2016). Factives have traditionally been thought to presuppose the truth of their complements, but the potential need for further differentiation was present from the start, beginning with the distinction between semi-factives (e.g. *discover*) and 'full' factives (e.g. *regret*) by Karttunen (1971). However, the precise nature of the differences involved has remained elusive in theoretical terms, and key empirical properties have been difficult to pin down experimentally (e.g. Jayez et al. 2015). We present new experimental evidence confirming specific differences between emotive factives (*be happy*, *appreciate*) and cognitive factives (*be aware*, *realize*) using a yes/no-continuation acceptability rating task (Cummins et al., 2013). We spell out an analysis of the demonstrated contrast in terms of a distinction between triggers based on whether or not their presupposed content is encoded as part of the conventionally entailed content (Sudo, 2012; Klinedinst, 2010), and also discuss the broader theoretical implications of our experimental results.

Keywords: semantics, experimental pragmatics, presupposition, factivity, entailment.

1. Introduction

1.1. Theoretical background

A central question in current presupposition theory concerns whether and how expressions that trigger presuppositions can be classified in different categories according to their semantic and pragmatic properties (cf. Abusch 2002; Simons 2007; Simons et al. 2010; Sudo 2012; Tonhauser et al. 2013; Romoli 2012; Abrusán 2016). We investigate this question with regards to *factive* presupposition triggers, i.e. expressions that presuppose the the truth of their complement clause. (1)-(2) illustrate that the truth of the embedded clause – that the proposal offended them – remains part of what is conveyed even under negation.

(1) a. I had discovered that the proposal offended them.
b. I had not discovered that the proposal offended them.

(2) a. I regretted that the proposal offended them.
b. I did not regret that the proposal offended them.

We present new experimental data pertaining to the difference between two types of factives: cognitive factives like *discover* and *find out* on the one hand, which convey a relation between a

[1] We would like to thank the audiences at SuB21, as well as various Schwarz Lab meetings for useful comments and discussion. Work on this project has been supported by NSF-grant BCS-1349009 to Florian Schwarz.

proposition and states or events relating to the subject's doxastic state, and emotive factives like *regret* and *be happy* on the other hand, which communicate a relation between a proposition and the subject's emotive affect towards it.

1.1.1. Empirical contrasts between cognitive and emotive factives

It was already noted by Karttunen (1971) that what he called "semi-factives" (such as *discover* and *find out*) can easily lose their presuppositional status. For example, they do not necessarily project from the antecedents of conditionals, in contrast to other factives such as *regret*, as illustrated in (3).

(3) a. If I discover later that the proposal offended them, I will apologize.
does NOT presuppose the proposal offended them.
b. If I regret later that the proposal offended them, I will apologize.
presupposes the proposal offended them.

(3a) conveys no commitment on part of the speaker to the proposition 'the proposal offended them', despite the fact that *discover* typically conveys the truth of its complement at a global level. Furthermore, cognitive factives can be used 'parenthetically' (e.g. Hooper and Thompson 1973; Simons 2007) by having the embedded clause answer a question, as shown in (4) from Simons (2007: p. 1035), whereas emotive factives typically cannot be used this way (5).

(4) A: Where was Harriet yesterday?
B: Henry discovered that **she had a job interview at Princeton**.

(5) A: Where was Harriet yesterday?
B: ?? Henry is happy that **she had a job interview at Princeton**.

In (4), B introduces *she had a job interview at Princeton* as the embedded clause of the cognitive factive *discovered* and uses it to introduce new, non-presupposed information to answer the question, which can certainly not be taken for granted. By contrast, in (5) it is introduced as the embedded clause of the emotive factive *is happy*, and here it seems to retain its presuppositional status: B's response is intuitively inappropriate, presumably because information that has the status of a presupposition is not suitable for addressing A's inquiry for new information about Harriet.

1.1.2. Theoretical approaches to the contrast

While the contrasts illustrated above go back to the beginnings of the linguistic literature on presuppositions, extensive discussion of explicit theoretical proposals for differentiating types of triggers only began in the early 2000's. One prominent proposal by Dorit Abusch (2002; 2010) distinguishes between 'soft' and 'hard' triggers, and assigns cognitives to the former category and emotives like *regret* to the latter.[2] The contrast above can then be seen as an

[2] Abusch never employs the terms *cognitive* and *emovitve*, but mentions Karttunen's discussion of *discover* as a case of soft trigger.

instance of a more general pattern, as the presuppositions of soft, but not hard triggers, are thought to be easily suspendable. For example, it is seen as parallel to the contrast between the soft trigger *win* and the hard trigger *too* illustrated in (6), from Jayez et al. (2015: p. 174; but note that these authors propose their own terminology and distinction in terms of 'strong' vs. 'weak' triggers).

(6) a. I don't know whether Paul participated in the race, but if he **won**, he must be very proud.
b. ?? I don't know whether Paul participated in the race, but if Mary participated **too**, they probably had a drink together just after.

The context in both cases establishes that the speaker is agnostic about Paul's participation in the race. In (6a), this does not seem to create a critical conflict with the notion of participation conveyed by *win*, which typically projects (from antecedents of conditionals and other standard projection environments) and is thus taken to be a presupposition. In contrast, in (6b), the agnostic preface seems to clash with the projecting presupposition that someone else (salient in the context, with Paul as the only feasible candidate) participated in the race.

Generally speaking, Abusch's analysis follows influential work by Stalnaker (1974) in assuming that (at least) certain presuppositions can be derived pragmatically, i.e., as a general conversational inference that is not conventionally encoded at the level of lexical meaning. In particular, Abusch puts forth an account based on lexical alternatives. Under this view, soft triggers are associated with a set of lexical alternatives (e.g. *win* is associated with the alternative *lose*). In addition, a context-sensitive pragmatic principle imposes that one member from the set of sentences where the alternatives are substituted in fact holds. In the case of soft triggers, the idea is that all the alternatives share an entailment (e.g., *win* and *lose* both entail participation), which results in the entailment being true regardless of which alternative turns out to be true. The suspendability of the presuppositions of soft triggers is then explained by the context-sensitivity of this pragmatic principle: given that the content that traditionally is seen as presupposed starts off as a simple conventional entailment of the trigger, the effect of the pragmatic principle can effectively lose its force, e.g., when this entailment is locally relevant. This is what happens in (6a) where Abusch's analysis represents the meaning of the conditional as *if Paul both participated and won*, and the effect of considering alternatives in the provided context does not give rise to a global notion that Paul participated.

In addition to Abusch, there are several other proposals taking a conversational approach to deriving presuppositions which differ in the details. For example, Romoli (2012) proposes an alternative-based pragmatic account of presuppositions, where soft presupposition triggers are assimilated to indirect scalar implicatures. A different type of pragmatic account has grown out of work by Mandy Simons and colleagues (Simons, 2007; Simons et al., 2010; Tonhauser et al., 2013). For these authors, the presuppositional status of a trigger depends crucially on the Question Under Discussion (QUD). I.e., whether or not part of the content introduced by an expression is treated as presupposed or backgrounded is determined relative to the conversational goals and issues at stake. Like Abusch and Romoli, they assume that factives entail the truth of their complement clause. For example, if the QUD is 'What happened?', then the content of the matrix clause (*Henry discovered that p*) constitutes the 'at-issue' part of the utterance, and *Harriet had a job interview at Princeton* is backgrounded and treated as part of the common ground, i.e., presupposed. If the QUD is 'Where was Harriet yesterday?', as in (4) and (5), then the content of the embedded clause *Harriet had a job interview at Princeton* is treated as new, at-issue information, which updates the common ground, i.e., it is not presupposed. The contrast between the cognitive and the emotive factives with respect to their ability to suspend their presupposition on this account then, would presumably need to be linked to a difference in their abilities to function parenthetically (see (4) and (5)).[3]

Taking a more general perspective, what's crucial for current purposes is that all of these pragmatic approaches involve the assumption that presupposition triggers lexically entail the content that eventually gets projected as a presupposition (that the embedded clause is true), for both cognitive and emotive factives. In contrast, we argue that the experimental data presented below suggests that this only holds for cognitive factives, and that the presupposition of emotive factives is not part of what is conventionally entailed. Such a distinction between triggers has been advanced by previous authors for other triggers, in particular Sudo (2012); Dahlman (2016).

1.2. Experimental background

While experimental work on presuppositions has only recently become a research area with significant growth, the aim of substantiating differences between different types of triggers has been a key driving force in it. For reasons of space, we will not attempt anything close to comprehensive coverage of this literature, but merely highlight a couple of especially relevant examples of prior research (for a recent review of experimental work on presuppositions more generally, see Schwarz 2016).

One of the early studies finding differences between triggers is Tiemann et al. (2011), who detect variation in acceptability judgments in contexts that do not explicitly support the trigger's presupposition, but are consistent with it. Similarly, Domaneschi et al. (2014) find that while some presupposition triggers leave a lasting impact – suggesting their presupposition is accommodated – others essentially seem to be ignored: after reading short texts containing various triggers followed by a distractor task, subjects are more likely to answer questions based on the contribution of triggers like *stop*, compared to a greater likelihood of failing to consider the presupposition such as that of the prefix *re-* (as in *reintroduce*). Tiemann (2014) and Tiemann et al. (2015) report a similar lack of consideration of the presupposition of *again* when answering questions, even without a delay in the task.

The just mentioned studies confirm some of the differences between triggers, in that the patterns of variation across triggers at least roughly match one of the theoretical divisions between types of triggers. But other studies that are more narrowly targeted at comparisons between specific triggers falling on opposite sides of a given proposal for a theoretical divide have failed to

[3]Note that while the QUD-based account certainly leaves room for differentiating triggers, it is not obvious what precisely it would say about the contrast between different types of factives.

yield clear confirmation of expected contrasts. For example, Schwarz (2014) compares the presumed 'soft' trigger *stop* with the 'hard' trigger *again* in terms of their processing time course. The results from visual world eye tracking suggest that both soft and hard triggers are processed rapidly, contrary to what might be expected based on (one line of) results on processing conversational implicatures, which can be presumed to share crucial features with soft triggers on certain pragmatic accounts. Furthermore, various attempts at comparing soft triggers to implicatures suggest that they differ in their processing profile, providing evidence against analyses that assimilate them (Chemla and Bott, 2013; Kennedy et al., 2015: among others). Yet another attempt at assessing a key part of the empirical claim with regards to the distinction between hard and soft triggers illustrated in (6) was made by Jayez et al. (2015). Their acceptability judgment study focusing on the hard triggers *too* and *regret* suggests that these, too, can fail to project from antecedents of conditionals in contexts that globally establish ignorance with respect to the truth of the presupposition, at least with sufficient contextual support.

Most relatedly to the experiments reported below, Cummins et al. (2013) and Amaral and Cummins (2015) investigate various triggers in English and Spanish and test the acceptability of *Yes, although* and *No, because* continuations, as illustrated for *again* and *stop* below:[4]

(7) Q: Did Brian lose his wallet again?
A: Yes, although he never lost it before.
A': No, because he never lost it before.

(8) Q: Did John stop smoking?
A: Yes, although he never smoked before.[5]
A': No, because he never smoked before.

Across all triggers that they looked at, both *yes* and *no* responses of this sort are degraded relative to controls, suggesting that contradicting the presupposition comes with a cost no matter what. But interestingly, the triggers in their results seem to be grouped into two classes with regards to the extent to which *yes,...* and *no,...* responses differ from one another: for expressions such as *stop* and *still*, there is a fairly substantial, statistically significant difference in acceptability between the response options, with higher ratings for *no* than for *yes*. In contrast, expressions such as *again* and *too* yield comparable acceptability ratings for both continuations.[6] Cummins et al. (2013) relate their results to the distinction between lexical and resolution triggers (Zeevat, 1992), but they broadly align with the soft-hard distinction as well. And in line with common claims about this distinction, the interpretation offered by these authors is indeed that the first set of triggers more easily allows for 'local accommodation' (Heim, 1983: i.e., an interpretation where presupposed content acts as if it were run-of-the-

[4]Similar tasks involving the selection of the best answer from a set of options had previously been used to investigate clefts and focus (Onea and Beaver, 2011; Velleman et al., 2012; Destruel et al., 2015).

[5]Note that Cummins et al. (2013) do not explicitly provide the continuations they used for *stop*, so this is our best guess at what they looked like for this question, which is listed in the materials in their appendix.

[6]Note that they also found *regret* to pattern with the first set of triggers, exhibiting a significant difference between continuations. This is directly relevant to our findings below, and at first sight may seem incompatible with them; see footnote 12 for our take on this.

mill entailed content), leading to relatively greater acceptability of the *no*-responses for these triggers. But there is a potential additional dimension to the variation as well, which can be related to Zeevat's notion of lexical triggers, which constitute cases where the presupposition is a requirement that comes with the asserted component of the trigger. As Amaral and Cummins (2015: p. 169) put it, in these cases 'the responses in condition [A; *yes*-continuation] appear self-contradictory, if we assume that the presupposition is a logical prerequisite for the at-issue content of the trigger.' In other words, the content introduced in the question cannot be affirmed independently of the presupposition. Our experiments below build on essentially this notion, though we couch it in a slightly different theoretical context.[7]

2. Experiments

The starting point for our investitagion is the hypothesis that we find different relationships between different subcomponents of meaning for emotive and cognitive factives. Generally speaking, both types of factives contribute (at least) two meaning components, that of the ATTITUDE involved (which relates the matrix subject's mental state to the embedded proposition), and that of the (EMBEDDED) proposition P (conveying that P is true). We propose that these two components stand in a different relationship to each other for the two types of factives, such that for emotive factives, P can be disentangled from the subject's ATTITUDE in a way that it cannot for cognitive factives. The basic intuition is that it is quite easy to imagine that one is *happy* about a certain state of affairs, but is simultaneously wrong about it. It is harder to see how one can *discover* something which is not true. Relatedly, (9a) is a coherent statement, whereas (9b) gives rise to contradiction:[8]

(9) a. John was happy that his parents are coming to town, although it turned out that he was in fact mistaken/although it turned out that they had to cancel.
b. ?? John discovered that his parents are coming to town, although it turned out that he was in fact mistaken/although it turned out that they had to cancel.

More specifically, we build on the proposal by Sudo (2012) that certain triggers (e.g., change of state verbs like *stop*) have their presupposition represented as part of the entailment at the lexical level, whereas others (such as gender features on pronoun or the additive presupposition of *also*) do not. Adapting this general approach, we hypothesize that cognitive and emotive factives differ in terms of their entailment properties — specifically, that P, while generally surfacing as projective content for both types of factives, is also part of the conventionally entailed content of cognitive factives, whereas it is not for emotive factives (Table 1).

[7] Note that a further directly related notion, that of certain triggers exhibiting 'Obligatory Local Effects,' has been introduced in recent work by Tonhauser et al. (2013).

[8] On this point, Egré (2008: p. 103) also observes that the emotive *regret* behaves differently from the cognitive *know* in false-belief environments.

Factive Type	COGNITIVE that P	EMOTIVE that P
Conventional Entailment	P & ATTITUDE	ATTITUDE

Table 1: Our hypothesis. Cognitives, but not factives, conventionally encode their embedded proposition P as part of their entailment.

We test this hypothesis using a yes/no-continuation task, similar to the above-mentioned one employed by Cummins et al. (2013) to explore differences between a range of triggers such as *stop* and *again*. The task pairs a factive question with a response of the form *yes, although...* or *no, because...*, followed by a denial of the content of the embedded proposition, as illustrated in (10).

(10) Q. Is Anna **aware/happy** that [$_p$ Ryan is coming to the wedding]? /
Does Anna **realize/appreciate** that [$_p$ Ryan is coming to the wedding]?
A1. Yes, although he isn't.
A2. No, because he isn't.

While the overall approach taken here is quite similar to that of Cummins et al., our hypothesis provides a slightly different angle on the expected outcomes by focusing on whether or not an affirmative answer is possible when the presupposition is explicitly denied at the same time. Our basic assumption is that a *yes*-response necessarily commits the speaker to the entailed content introduced by the question. However, it may in principle be possible to deny a presupposition, to the extent that it is introduced entirely at a separate level and not part of the conventionally entailed content. This leads to diverging predictions based on our hypothesis: if the content of the embedded proposition is entailed, as we propose is the case for the cognitive factives, saying *yes* and then denying the content of the embedded proposition should be contradictory, and thus only *no* will be a viable response. But for the emotive factives, where we hypothesize that the content of the embedded proposition is not part of what is entailed, it should in principle be possible to just endorse the (emotive) ATTITUDE by responding *yes*, even if qualifying immediately by noting that the embedded proposition is false – i.e. singling out one aspect of the meaning (the entailed content: ATTITUDE) while contesting another aspect (P). Note that homing in on one particular aspect of meaning in your affirmation may still come at a cost, i.e., it is indeed plausible that the default impact of an affirmation involves endorsing both entailed and presupposed content, wholesale, as it were. What's crucial for our approach is that in principle it may be possible that non-entailed presuppositions can be denied along with a *yes*-response, while entailed ones cannot. If so, that leads to a prediction for our hypothesized difference between cognitive and emotive factives, namely that the latter should yield a greater acceptance of *yes*-responses than the former. Note that the hypothesis makes no specific prediction for the relative acceptability of denials of presupposed content with *no*-continuations, which require targeting the presupposed content with negation (commonly analyzed as involving local accommodation). It's possible that the different relationship between presuppositions and entailments has a reflex here, too, but this does not necessarily follow from our hypothesis. In the following, we report on two experiments to test these predictions: Experiment 1, where the participants were asked to chose which of the *yes* vs. *no* answer-options they preferred, and

Experiment 2, which uses acceptability ratings to home in on the acceptability of *yes*-responses more directly.

2.1. Experiment 1

2.1.1. Design

In Experiment 1, participants were presented with questions containing a cognitive or an emotive factives and had to indicate their preference with resepct to *yes* and *no*-answer options. There were additional response options to express that 'Both options are equally good.' or 'Both options are equally bad.'

(11) Q. {Did Mark **find out**/Was Mark **surprised**} that [$_{PS}$ his parents are visiting]?
A1. Yes, although they had to cancel because of the weather.
A2. No, because they had to cancel because of the weather.
A3. Both options are equally good.
A4. Both options are equally bad.

If, as hypothesized, cognitives but not emotives entail the content of the proposition they embed, we expect that the *yes*-responses should be more readily available for the questions with an emotive facctive, compared to those with a cognitive one. That is, for the emotive factives, we expect both the *yes* and the *no*-responses to be in principle available. Assuming more or less comparable availability of the *yes* and *no*-responses, the *both good* and *both bad* responses should be chosen more frequently for emotive factives (depending on how the potential cost of local accommodation (for *no*) or targeting only one aspect of meaning (for *yes*) affects acceptability judgments). For the cognitive factives on the other hand, we expect these to allow only the *no*-responses, as these should be clearly better than *yes*-resonses (even if involving some cost for local accommodation). Hence, *both good* should be impossible with the cognitive factives, given the unacceptability of the *yes*-response. The *both bad* option might get chosen for the cognitive factives, if subjects dislike both local accommodation and cancellation/suspension. However, this is likely to be the dispreferred choice, assuming that local accommodation does make *no*-responses available.

2.1.2. Participants

Thirty-six native speakers of English participated in the study. The participants were recruited on Prolific.ac, a crowd-sourcing tool for recruiting participants to participate in scientific studies online. Participants were paid at rate of 5.20 GBP per hour for their participation. The task took approximately 10 minutes to complete. No participant was excluded from the analyses.

2.1.3. Materials

All items presented short written dialogues between two speakers. There were two variations of twenty-four experimental items, corresponding to the two predicate types: COGNITIVE (*re-*

alize, *find out*) and EMOTIVE (*be disappointed*, *be surprised*) factives, as illustrated in (11) above. Each subject only saw a given item in one version, with item-condition pairings counterbalanced across subjects. In addition, there were twenty-four filler items where factives were paired with different continuations. Given the prediction for the critical part of the experiment, that the *yes*-responses should be endorsed to a greater extent in the EMOTIVE condition than in the COGNITIVE condition, the fillers were designed to yield the opposite preference. Hence, among the fillers, the emotive factives favoured a *no*-response, and the cognitive factive favoured a *yes*-response, as illustrated in (12) and (13), in order to counteract the potential risk of introducing an overall bias against the *yes*-responses. The *both good* and *both bad* options in (A3) and (A4) were available for the fillers, too.

(12) Emotive filler:
Q. Was Mike disappointed that John decided to quit football?
A1. Yes, although he didn't think John was a very good player.
A2. No, because he didn't think John was a very good player.

(13) Cognitive filler:
Q. Was Mary surprised that Bill got the grant?
A1. Yes, although she was on the grant committee.
A2. No, because she was on the grant committee.

The participants were given the following instructions: "In this experiment you will read short questions. You will then be asked to choose which answer you prefer, given a choice of two answers. You also have the opportunity to say that you think that both answers are equally good or equally bad. There is not a right or a wrong answer. Simply choose the answer that you prefer, given the preceding question." In order to control for variability stemming from the two predicate types influencing the answers across conditions, we used a block design. Thus, half of the participants saw the emotive factives in a randomized order first, and the cognitive factives in a randomized order last, and vice versa for the other half of the participants. Each block contained both fillers and critical items. Additionally, the items were divided into two groups, in order for each specific predicate to be evenly distributed across participants, thus creating a two-by-two Latin square design.[9]

2.1.4. Analysis

The results were analyzed as logistic mixed effects regression models in R (version 3.1.2) using the *glmer* function of the *lme*4 package (version 1.1-11) and its *bobyqa* optimizer. Results from maximally complex converging models are reported here (Barr et al., 2013). We ran four types of models regarding the predicted outcomes: models predicting the observation of a *yes*-response (to the exclusion of all the others), of a *no*-response (to the exclusion of all the others), of a *both good*-response (to the exclusion of all the others) and of a *both bad*-response (to the exclusion of all the others). They tested for a fixed effect of predicate type (EMOTIVE, COGNITIVE). For each of these simple-effect models, we also ran a version testing for an

[9]The experiment is available at: `http://spellout.net/ibexexps/SchwarzLabArchive/YesNoFact/experiment.html`

effect of block order (EMOTIVE-COGNITIVE, COGNITIVE-EMOTIVE) and its interaction with predicate type. Participants and items were added as random effects, with a random slope for predicate type per participant, and a random slope for predicate type and block order (in the relevant models) per item. Our different baselines exhausted the logical space of effects and interactions. The models did not include data-points for the filler items, and no other data-point was excluded.

2.1.5. Results

The results are summarized in Figure 1. The response patterns for the first block showed a clear contrast between the cognitive and the emotive factives. There was a main effect of predicate type on the observation of *no*- and *both bad*-responses in the first block (resp. $p = 0.00247$, $\beta = 1.2433$, $SE = 0.4107$ and $p = 0.024687$, $\beta = 1.6566$, $SE = 0.7375$), with *no*-responses being more frequent for the cognitive factives and *both bad*-responses being more frequent for the emotive factives. There was also a significant interaction with block order for the *no*-responses ($p = 0.02423$, $\beta = 1.3729$, $SE = 0.6092$) but not for the *both bad*-responses; the significant main effects between the two types of factives disappeared in the second block (predicate type for *no* $p = 0.7260$, $\beta = 0.12959$, $SE = 0.36983$; predicate type for *both bad* $p = 0.678$, $\beta = 0.3225$, $SE = 0.7768$), suggesting that exposure to one type of factive predicate had a strong effect on the participants' responses, potentially through priming one type of interpretation, or through adjusting the participants' standards for evaluation. There was no such significant main effect on the observation of *yes*- and *both good*-responses (all $p > 0.17$, $\beta \leq 0.5$). We observed the same results in simple models, excluding block order as a predictor: *no*- and *both bad*-responses were more frequent with cognitives than with emotives (*no*: $p = 0.0222$, $\beta = 0.5266$, $SE = 0.2303$; *both bad*: $p = 0.0223$, $\beta = 0.7232$, $SE = 0.3165$) but there was no significant effect of predicate type for *yes*- and *both good*-responses (*yes*: $p = 0.737$, $\beta = 0.08468$, $SE = 0.25253$; *both good*: $p = 0.809$, $\beta = 0.07354$, $SE = 0.30382$).

Figure 1: **Left:** proportion of responses for the two types of factives in block 1, where the contrast between the cognitive and the emotive factives is significant for the *no* and the *both bad*-responses. **Center and right:** responses for the four response types (*yes*, *no*, *both good*, *both bad*), by block. The contrast between the two types of factives is neutralized in block 2.

To summarize, even though the contrasts between the two verbs are subtle, and subject to influencing each other across blocks, there is nonetheless a clear contrast between the two types of factives with respect to the availability of *no*-responses. Even though there was no direct, visible contrast in the availability of *yes*-responses and *both good*-responses, the contrast in *both bad*-responses is in line with our hypothesis, according to which the two aspects of meaning identified as part of the semantics of the two types of factives (the ATTITUDE and the (EMBEDDED) P components) contribute to the overall semantic properties in different ways for the emotive and the cognitive factives — specifically in terms of the truth of the embedded clause being part of the conventional entailment in the case of cognitive factives, but not for the emotive factives. Under this view, participants were not sufficiently inclined to consider an interpretation where either negation targeted P directly or where an affirmative response selectively endorsed the conventionally entailed content (for emotive factives). At the same time, participants did display a sensitivity to the contrast in entailment in that they were more amenable to accepting a *no*-response for cognitive factives, because it should be easier to target the embedded proposition P with negation when it is conventionally entailed.

However, there is at least one alternative interpretation of the results which basically attributes the contrast in *no*-responses to varying availability of local accommodation, and does not posit a difference between factives in terms of whether or not P is part of the conventionally entailed content. To spell out a specific version of this alternative, it might be that only emotives are lexically associated with a conventional presupposition that P (which at the same time is part of the entailed content as well). In contrast, the presuppositional status of P would result from a pragmatic derivation in the case of cognitive factives, in line with the proposals by Simons, Romoli and others. Based on these assumptions, *no*-responses for cognitives are expected to be easily acceptable, to the extent that the pragmatic derivation does not (or at least not necessarily) take place under negation.[10] For emotives on the other hand, both a *yes* and a *no*-response would require cancellation of a hard-coded, conventional presupposition, which would lead participants to generally prefer the *both bad* response to indicate a presupposition failure.

In order to disambiguate between these two interpretations of the results, Experiment 2 used an acceptability rating task where subjects were only presented with one answer option at a time. This allowed us to test for a contrast in the acceptability of *yes*-responses between the two types of factives more directly. As discussed above, our hypothesis predicts that *yes*-responses paired with denials of P will be more readily available for emotive factives than for cognitive factives. In contrast, the alternative interpretation we just considered does *not* predict such a contrast in the *yes*-responses, as both types of factives should yield low ratings for *yes*-responses, based on the crucial assumption that factives uniformly include a conventional entailment that P.

[10]For Romoli in particular, the justification after *no* would block or cancel this derivation, in the same way that the *sometimes* implicature normally associated with *not always* does not arise in *I don't always curse because I never curse*).

2.2. Experiment 2

2.2.1. Design

Experiment 2 used an acceptability rating task to provide an independent assessment of the acctability of *yes* and *no* continuations. Participants saw only one response at a time (*yes, although...* or *no, because...*), as shown in (14) and (15).

(14) Q. {Is Maria **aware /happy**} that [$_P$ Mike is moving back to Chicago]?
A1. Yes, although he isn't.

(15) Q. {Is Maria **aware**/Is Maria **happy**} that [$_P$ Mike is moving back to Chicago]?
A2. No, because he isn't.

Specifically, the participants were asked to rate to what extent the answer sounds natural to them, in light of the question, by choosing a value between 1 ('completely unnatural') to 7 ('completely natural') by clicking the number or pressing the corresponding key. They were instructed that there was no right or wrong answer. If cognitive, but not emotive factives conventionally entail P, then we expect to see a contrast between the cognitive and the emotive factives in the *yes*-responses, such that *yes* is rated significantly lower for the cognitives than for the emotives. Again, no specific predictions were made for the *no*-responses. In addition to the slight change in the nature of the task, the stimuli were refined from Experiment 1 to be more uniform, in particular by consistently using future-oriented progressive forms (e.g., *is moving to Chicago*) in the embedded clause and expressing denial in the response-continuation via VP-ellipsis. This was done to avoid potential other pragmatic strategies of reconciling the denial with the initial affirmative or negative response, which may have given rise to additional variation in response patterns for the original set of materials.

2.2.2. Participants

Sixty-two undergraduate students at the University of Pennsylvania, all native speakers of English, participated in the study for course credit through the Psychology department's subject pool. The experiment took approximately 15 minutes, and was carried out on lab computers.

2.2.3. Materials

As illustrated above, the items consisted of short dialogues between two speakers, as in (14), (15). Versions of the twenty-four critical items were created in four conditions, corresponding to the two predicate types—cognitive and emotive, and the two answer types—*yes, although* and *no, because*. We also included a between item adjective-verb manipulation, such that half of the items contained verbal factives (*appreciate, realize*), and half of them, adjectival factives (*happy, aware*). Forty-eight filler items were also included. These were designed with two purposes in mind: first, to provide a floor and a ceiling baseline for the *yes*- and *no*-responses; and second, to counterbalance the number of good and bad *yes*- and *no*-responses. Half of the fillers were therefore constructed using a non-factive matrix predicate (*think*), where the *no*-

answers would be infelicitous, and the *yes*-answers would be fully acceptable, as in (16). The other half of the fillers involved a question with two conjuncts, as in (17). Here, it would be the *yes*-answers that were infelicitous, while *no* would be an acceptable response.

(16) Q. Does Sue think that Bill's parents are going to the wedding?
A1. #No, because they are. ('Bad Control')
A2. ✓Yes, although they aren't. ('Good Control')

(17) Q. Is John going to Paris and Rome this summer?
A1. ✓No, he's not. ('Good Control')
A2. #Yes, although he isn't going to Rome. ('Bad Control')

The participants were given the following instructions: "In this experiment you will read short dialogues between two people in the form of a question and an answer. You will then be asked to rate to what extent the answer sounds natural to you in light of the question, by choosing a value between 'completely unnatural' (1) to 'completely natural' (7). There is not a right or a wrong answer. Simply make the choice based on how well you feel the answer works for the preceding question." In contrast to Experiment 1, the factive and emotive items were randomly mixed, but answer type (*yes* vs. *no*) was separated by blocks, with order counter-balanced across groups.[11]

2.2.4. Analysis

The ratings were analyzed using linear mixed effects regression models in R (version 3.1.2), using the *lmer* function of the *lme*4 package (version 1.1-11). All our models included predicate type (EMOTIVE, COGNITIVE) and answer type (YES, NO) as fixed effects. Given that we didn't make predictions regarding syntactic category (ADJECTIVE, VERB) nor block order (YES-NO, NO-YES), we fitted models excluding them both (simple models) and models including either one of them as predictors (models including both of them would not converge). We tested for the maximally complex models, including all possible interactions of predictors and all random slopes for participants and items as random effects, and our different baselines exhausted the logical space of effects and interactions. The models only included the data points of the experimental items.

2.2.5. Results

The results are presented in Figure 2. Responses were similar in the first and second block (main effects $t \leq 1.35$, $\beta \leq 0.45$; two-way interactions $t \leq 0.3$, $\beta \leq 0.15$; three-way interaction $t = 0.302$, $\beta = 0.13988$, $SE = 0.43359$) and for adjectives and verbs (main effects $t \leq 1.5$, $\beta \leq 0.35$; two-way interactions $t \leq 1.63$, $\beta \leq 0.44$; three-way interaction $t = 1.216$, $\beta = 0.37898$, $SE = 0.31167$). As predicted, the response patterns showed the *yes*-ratings to be significantly higher for the emotive than for the cognitive factives (simple model: $t = 4.954$, $\beta = 0.76$, $SE = 0.1534$; $t \geq 3.1$ and $\beta \geq 0.59$ otherwise), with no difference in the *no*-ratings (simple

[11] The experiment is available at:
`http://spellout.net/ibexexps/SchwarzLabArchive/YesNoRating/experiment.html?Home=true`

model: $t = 0.625$, $\beta = 0,1005$, $SE = 0.1607$; $t \leq 0.785$ and $\beta \leq 0.1683$ otherwise). There was also an interaction between predicate type and answer type (simple model: $t = 4.083$, $\beta = 0.8605$, $SE = 0.2108$; $t \geq 2.61$ and $\beta \geq 0.67$ otherwise).

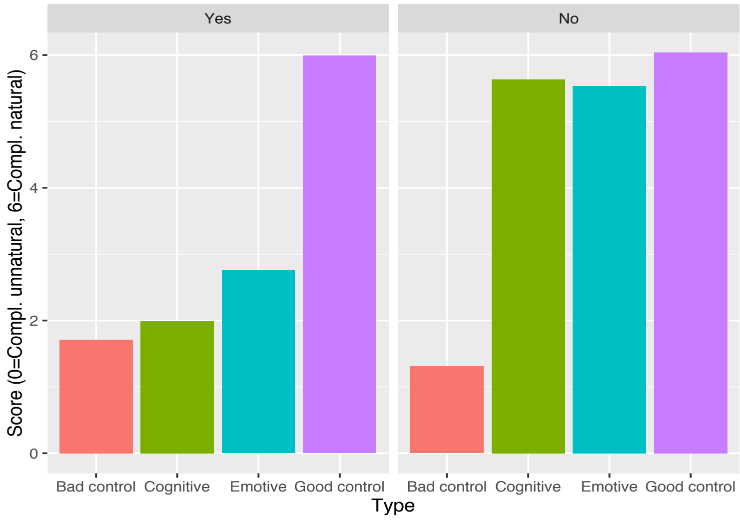

Figure 2: Mean ratings by answer type and predicate type (merged blocks).

With this experiment, we replicated the main conceptual result from Experiment 1, in that we elicited a contrast between emotive and cognitive factives. The contrast no longer consists in participants endorsing *no*-answers more readily as responses to cognitives than to emotives; rather, we now see that participants deem *yes*-answers relatively more natural as responses to emotives than to cognitives.[12] Importantly, the results from Experiment 1 were not only compatible with our hypothesis, but also with an alternative hypothesis based on potential differences in the availability of local accommodation. However, the results from Experiment 2 are not in line with the predictions of such an alternative view: that view assumes that P is conventionally entailed both by cognitive and emotive factives, therefore *yes*-answers should be rated as low for emotive as for cognitive factive questions (under the assumption that *yes* commits the speaker to all the entailed content). On the other hand, our hypothesis in well in line with the results: participants were able to understand the affirmative reply as singling out the entailed content to the exclusion of the embedded proposition P to some extent for emotives. This led to an increase in acceptability of *yes*-continuations, in contrast to cognitives, which were visibly as low as the baseline controls in this regard. This is consistent with the idea that emotives do not, but cognitives do, conventionally entail P, given the assumption that it is in principle possible to selectively affirm the conventionally entailed content with a *yes*-response.

3. Discussion

Taken together, the results from Experiment 1 and Experiment 2 support the hypothesis we advance, that cognitive and emotive factives differ in terms of whether the truth of the embedded

[12] Cummins et al. (2013) report results for *regret*, which look similar to other triggers that we would see as candidates for entailing their presupposition. However, there is no direct point of comparison to other types of factives, and furthermore, their materials seem pragmatically skewed by using embedded clauses that the matrix subject is virtually guaranteed to be an informed authority on, such as *Did Fiona regret buying the house?*.

clause is part of what is conventionally entailed (in addition to being presupposed). While the first experiment did not support that notion directly, the results were perfectly consistent with this notion, but they also could be explained by an alternative hypothesis that locates the difference entirely in terms of the interaction of negation (and more generally, *no*-answers) with different triggers. Experiment 2 sought to get a more direct comparison of the acceptability of *yes*-responses paired with a denial of the presupposition, and found a significant difference (and corresponding interactions) between the two types of factives. This showed that an explanation of the contrast has to extend beyond negation, which our hypothesis does but the alternative one does not provide. That said, there are various aspects of the results as well as the broader theoretical discussion that merit further consideration.

The first issue to raise here is the absence of a contrast in ratings for the *no*-answers in Experiment 2, which contrasts with what we observed in Experiment 1. We suggested that *no*-responses were more likely to be selected with the cognitive factives because it is easier for negation to target the embedded proposition P when it is part of the conventionally entailed content. In the case of the emotives, this requires allowing negation to target purely presuppositional content, which may come with some cost (e.g., through local accommodation). But based on this interpretation, it may seem a bit surprising that we did not find parallel results for Experiment 2, where no difference in acceptability between *no*-answers for emotive and cognitive factives emerged. While we can't offer a full-fledged explanation for this, there are a number of tentative points to offer that suggests that this need not undermine our proposal. To begin with, the two experiments differed not only in the explicit task, but also in several other details of implementation. While the choice of an appropriate response in Experiment 1 could be seen as closer to a production situation, the acceptability rating task in Experiment 2 primarily involved comprehension (plus assessment of an observed dialogue). It is at least possible that this introduces an asymmetry in terms of how likely people are to call upon a mechanism such as local accommodation: in Experiment 1, it was easy to avoid such a move by choosing a different response choice, whereas in Experiment 2, it may have offered itself as the last resort for taking the presented dialogue to be plausible. Furthermore, the block manipulations in the two experiments were different: Experiment 1 separated the two types of factives into separate blocks, whereas Experiment two had different blocks for *yes* and *no*-continuations, with factive types mixed with blocks. Thus the lack of an effect for negation in the latter may simply parallel the block order effect in Experiment 1, where no differences emerged between factive types in the second block. Finally, it is worth noting that the issue we're addressing effectively is based on a null effect, and the absence of evidence in this regard should not be mistaken as evidence against our hypothesis. The core of our line of argument is that there is a difference between emotive and cognitive factives in terms of conventional entailment, and that we can find *positive* evidence for *non-entailment*, which we did.

We should also address why no difference between types of factives in the acceptability of the *yes*-responses emerged in Experiment 1: both *yes* and *both good* choices were equally low there for cognitives and emotives, whereas in Experiment 2, *yes*-answers were judged to be more natural for emotives. As already noted in connection with the preceding point, the two experiments differed in various relevant respects, in particular with regards to choosing an appropriate response vs. providing a graded assessment of the acceptability of a fixed response. While the contrast between the different types of factives had an impact in both tasks, the persistent global presence of the truth of the embedded proposition for emotives seems to have decreased selection of either response in Experiment 1, suggesting that participants were reluctant to select a response with an unsupported presupposition from an emotive factive. That *no*-responses were much more readily selected and clearly preferred, for cognitives, fits the notion that their presuppositions are less persistent than those of emotives, echoing the claim that presuppositions of soft triggers are more easily suspendable that those of hard triggers (Abusch, 2002). As discussed earlier, expressions that have been claimed to project part of their conventionally entailed content (as we claim is the case for cognitive factives) tend to fall in the category of soft triggers, whereas expressions that have been claimed to trigger a presupposition independent from their conventionally entailed content (as we claim for emotive factives) generally fall in the category of hard triggers. Note that we here have tried to remain neutral as to the source of the projective content of factives, leaving open the possibility that in the case of cognitive factives, it could be derived as a type of implicature *à la* Romoli (2012) or a conversational inference more generally, based on the presence of the relevant proposition at the level of the conventionally entailed content. In contrast, this type of analysis is not available for the emotives, given our interpretation of the data. One obvious remaining option then is to posit that in the case of emotive factives, we are dealing with a conventionally encoded presupposition that is NOT simultaneously present at the level of conventionally entailed content.

However, there is at least one further alternative, which relates to the question of what exactly is involved in the ATTITUDE component, in particular in the case of emotive factives.[13] To spell out this option, let us first step back and return to the possibility of deriving the factive inference for cognitive factives: the original source of this content is in the conventional entailments at the lexical level, on this view. Its special status, leading to projection behavior is derived in one way or another based on the notion that one can distinguish between different pieces of meaning at this level namely i. that the subject believes (or has come to believe, etc.) that P, and ii. that P holds. In contrast, the information conveyed by an emotive factive expression like *be happy that* P seems to ultimately involve at least three pieces: i. that the subject has an emotionally positive attitude towards P, ii. that P holds, and iii. that the subject believes that P holds. So while there clearly is only one ingredient to the ATTITUDE component of cognitives (i), there could be any combination of (i) and (iii) that is lexically encoded to form the ATTITUDE component of emotives. Relating this to our experimental results, note that any of these options would be compatible with our interpretation of the experimental results above, given that none of the considered ATTITUDE components entail P. Once we incorporate all three pieces of information into our considerations, further candidates for a conventionally encoded *presupposition* of emotives enter the picture. In addition to the option noted above that P (ii) be treated as a hard-coded presupposition, one could well imagine that emotives conventionally encode the subject's belief that P (iii) as a presupposition and derive the stronger inference that P in fact holds conversationally, based on assumptions about the well-informedness and authority of the attitude holder. Alternatively, the 'belief-presupposition' (iii) could also be part of what is conventionally entailed, and emotive factives would then entail this presupposition. This would still be consistent with our interpretation of the experimental results, since neither the presuppositional nor the conventionally entailed content of emotive factives would

[13]Thanks to Valentine Hacquard for discussion leading to our consideration of this possibility.

then contribute that P holds: this would only emerge as a possibly defeasible inference from the presupposition that the subject believes P. In summary, once we think more broadly about precisely what ingredients there are to the meaning of emotive factives, more options open up, including one where a belief-presupposition of emotives is represented at the level of conventional entailments. While this would make cognitive and emotive factives more similar again on an abstract level, there would still be a substantive difference with regards to the role of the embedded proposition P (which would still be entailed for cognitives but not for emotives on the view under consideration).

Regardless of where one comes down on these more intricate issues, the interpretation of our data is as follows: Our starting point was the long-standing observation that i. the complements of factives in general (i.e., both cognitive and emotive) are typically projected as true or impose restriction on the context of utterance, but ii. they differ in the extent to which they do so. Our proposal is that the content of the proposition that factives embed is also part of what is conventionally entailed in the case of cognitives, but not in the case of emotives. The experimental results we obtained and presented here support this proposal, and even the final alternative analysis we just discussed would wind up embracing it by assuming that emotives neither presuppose nor conventionally entail the truth of the proposition they embed, as it maintains that the truth of the embedded proposition could be derived from other conventionally encoded content. In the end, the various analyses that we discussed share precisely this property, while crucially differing on how the truth of the embedded proposition ends up as part of the conveyed content, with behavior that suggests it is (generally) projective and imposes constraints on the context of utterance, as presuppositions are traditionally thought to do.

4. Conclusion

We presented two experiments investigating the role of the embedded proposition of both cognitive and emotive factives, using a *yes/no*-continuation task. Taken together, the experiments suggest that while the embedded proposition of cognitives inevitably gets embraced by affirmative responses to questions, this is not necessarily so for emotives. We interpret these results in terms of a more general distinction between presupposition triggers, where some – like cognitives – entail their presupposition, whereas others – like emotives – do not. This interpretation rules out certain pragmatic accounts of emotives, but leaves open at least two theoretical paths for introducing their factive presupposition, either in terms of conventionally encoding them at the presuppositional level (and only at the presuppositional level), or by deriving them from other ingredients, such as the belief-component that seems to be involved in emotives as well.

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When is not-believing believing that not?[1]

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Abstract. We present two experiments that studied the licensing conditions of two Czech expressions in neg-raising and non-neg-raising environments: *ani jeden* 'even one' and *až do* 'until'. English counterparts of these expressions are often treated as belonging to the same class, that of strict NPIs. However, our experiments revealed subtle differences between the two expressions, which we argue could be explained if we assume that only *ani jeden* 'even one' is a strict NPI, while *až do* 'until' is an expression sensitive to durativity of the predicate it modifies. The experiments furthermore showed that mood affects licensing of both *ani jeden* 'even one' and *až do* 'until' under neg-raising predicates. The role of mood on licensing is explained in Romoli's theory of neg-raising.

Keywords: Neg-raising, NPIs, mood, experimental semantics, Czech

1. Introduction

In this article we focus on an interaction of two phenomena: Neg-raising (NR) and Negative Polarity Items (NPIs) licensing. The phenomena have been treated as connected since the first formal approaches to NR. In particular, strict NPI licensing is standardly taken as a test of NR-hood (see Lakoff 1969 and Horn 1989, among others). NR is exemplified with (1): (1a) is in most contexts understood as (1b) – and this interpretation is the so-called NR reading of (1a).

(1) a. John doesn't believe that Mary was here.
b. ⇝ John believes that Mary wasn't here.

The article has two aims: an empirical and a theoretical one. In the empirical part, we present new experimental data from Czech on NR and NPIs. The data show that the choice of mood (indicative vs. subjunctive) has an effect on licensing expressions sensitive to negation (NPIs being one main representative of such a category). Second, the data also show that not all expressions sensitive to negation are equal: in particular, we will observe that expressions like 'even' have a very different behavior from expressions like 'until' when interacting with negation. The theoretical point of the article is the argument that the effect of mood can be captured in Romoli's theory of NR-hood (Romoli, 2013), and that 'until' should not be classified in Czech as a strict NPI, in contrast to English.

The main part of the article discusses two experiments on NR, NPIs and mood, and the theoretical consequences of the experimental results. Before turning to the experiments and the theory, we need to prepare the ground. We begin so by giving a necessary background on Czech expressions sensitive to negation.

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2. Czech expressions sensitive to negation

In Czech, there are at least three groups of expressions sensitive to negation.

First, there is a class of weak NPIs, which is represented by the NP *sebemenší tušení* 'slightest suspicion'. We can see that it is a weak NPI since it requires a downward entailing (DE) environment in the at-issue meaning – see (2) – a standard condition for weak NPIs. There doesn't seem to be any locality constraint between this NPI and its licensor.

(2) Nikdo/málo lidí/*někdo o tom (ne)-měl-o/-0 sebemenší tušení.
nobody/few people/*somebody about that had slightest suspicion
'Nobody/few people/*somebody had slightest suspicion about that.'

In this article we stay agnostic as to the exact mechanism of weak NPI licensing (see, e.g., Gajewski 2011 and Crnič 2014 for two recent proposals). In fact, weak NPIs will not play any role in the following sections.

The second class consists of strict NPIs. These can be represented by NPs such as *ani jeden článek* 'not even one article'. Currently, several theoretical approches to strict NPIs co-exist (see Zwarts 1998, Giannakidou 2006, Gajewski 2011, Collins et al. 2014). Here, we will use that of Zwarts (1998): strict NPIs are licensed by anti-additive functions. Anti-additive functions are defined in (3).

(3) A downward-entailing function *f* is anti-additive iff for any *a* and *b* in the domain of *f*, $f(a)$ and $f(b) \leftrightarrow f(a \text{ or } b)$.

The condition of anti-additivity can explain why we observe the difference between (2) where the DE quantifier *málo lidí* 'few people' licensed the weak NPI and (4) where the licensing of the strict NPI is invalid:

(4) Nikdo/*málo lidí/*někdo (ne)-přečetl ani jeden článek.
nobody/*few people/*somebody read even one article
'Nobody/*few people/*somebody read even one article.'

On Zwarts' account, the explanation lies in the fact that the quantifier *málo lidí* is not anti-additive. To see this, consider a situation with six students, 3 of them dancing and (other) 3 of them singing. Assuming that 3 but not 6 is seen as a small number, the sentence *Few students were dancing and few students were singing* is true but the sentence *Few students were dancing or singing* is not – that is, the anti-additive condition is not satisfied by the DE quantifier *few people*). In general, since anti-additive licensors are a proper subset of DE licensors (see, e.g., Gajewski 2011) strict NPIs appear in some, but not all, environments that license weak NPIs.

A third class of expressions sensitive to negation are expressions of the type *až do* 'until + time expression', see (5).[2]

(5) Vojáci se *(ne)vystřídali až do půlnoci.
soldiers SE neg-change till to midnight
'The soldiers will not change until midnight.'

The English counterpart of *až do* is often taken as a good candidate for strict NPIs (when combining with predicates denoting episodic events). It is also widely used in testing NR properties of predicates (cf. Gajewski 2011, Romoli 2013). Nevertheless, we treat the Czech expression as a separate type. In particular, we assume it is an expression sensitive to durativity of the modified predicate (ESD), as can be seen by the fact that the Czech *až do* can appear with stative predicates, (6). The negative version of (5) is possible because negation changes a punctual predicate into a durative one (Krifka 1989, a.o.). We are not the first to take this position. In particular, *until* in English has been analyzed along this line by Smith (1974) and Mittwoch (1977). However, at least since Karttunen (1974), this type of analysis has been often challenged/substituted by an approach that postulates two types of *until*, one of which is sensitive to durativity and another one that appears with episodic predicates and is a strict NPI (see De Swart 1996 for a detailed discussion).

(6) Vojáci zůstanou až do půlnoci.
soldiers stay till to midnight
'The soldiers will stay until midnight.'

While we have nothing to say about the English case, we do have a novel argument that the Czech *až do* should not be analyzed this way. As we will demonstrate in the following part of the article, Czech examples containing *až do* 'until' with punctual predicates like (5) are very different from parallel cases of strict NPIs.

3. Experiments

In this section we describe the design of two experiments pertinent to the topic of the article. Both experiments targeted NR, NPI licensing and various factors influencing the licensing.

3.1. Experiment 1

The first experiment tested whether expressions sensitive to negation are accepted in clauses embedded under negated NR and non-NR predicates and how mood of the embedded predicate

[2] Apart from these three groups, Czech also has n-words (expressions requiring clause-mate negation):

(i) Nikdo *(ne)spal.
Nobody not-slept.
'Nobody slept.'

This class of negative expressions will not play any role in the rest of the article.

influences the acceptability. The experiment was a 3x2x2 design.

Three types of predicates were used (Condition: PREDICATE):

1. opinion class of NRs – see (7) for an item with a strict NPI;
2. probability class of NRs – see (8) for an item with a strict NPI;
3. non-NR predicates (mostly communication and causative verbs) – see (9) for an item with a strict NPI

All predicates embedded either indicative or subjunctive mood (Condition: MOOD). Finally, two types of expressions sensitive to negation were tested: either the strict NPI *ani jeden ...* 'not even one' or the ESD *až do* 'until' (Condition: NEGATIVE EXPRESSION). While the first two conditions were tested within items, the last one was a between-item condition. This was so because it would be hard, if not impossible, to have sentences that could be fully parallel up to the NPI/ESD difference.

An example with strict NPIs for opinion, probability and non-NR predicates are given here.

(7) Nemyslím, že 0/by ani jeden z běžců může/mohl ten závod vyhrát.
do-not-think-I that IND/SUBJ even one of runners can/could the race win
'I don't think that even one of the runners can/could win the race.'

(8) Není možné, že 0/by ani jeden z běžců může/mohl ten závod vyhrát.
it's-not possible that IND/SUBJ even one of runners can/could the race win
'It's not possible that even one of the runners can/could win the race.'

(9) Netvrdím, že 0/by ani jeden z běžců může/mohl ten závod vyhrát.
do-not-say-I that IND/SUBJ even one of runners can/could the race win
'I don't say that even one of the runners can/could win the race.'

The example items with ESDs *až do* 'until' are shown below for the same three predicate classes.

(10) Majitel toho hotelu neví, že 0/by kuchaři odjeli až do konce měsíce.
owner this hotel not-knows that IND/SUBJ cooks left up to end month
'The owner of this hotel doesn't know that cooks would leave/left until the end of the month.'

(11) Podle majitele toho hotelu není možné, že 0/by kuchaři odjeli až do
according owner this hotel not possible that IND/SUBJ cooks left up to
konce měsíce.
end month
'According to the new owner of the hotel it's not possible for the cooks to leave until the end of the month.'

(12) Majitel toho hotelu se nedoslechl, že 0/by kuchaři odjeli až do
owner this hotel not-hear that IND/SUBJ cooks left up to end
konce měsíce.
month
'The owner of this hotel doesn't hear that cooks would leave/left until the end of the month.'

The participants in this experiment judged acceptability of the items on 5-point Likert scale (5=best, 1=worst).

There were 36 experimental items. 18 experimental items were constructed with the ESD *až do* 'until', 18 experimental items appeared with the strict NPI *ani jeden* 'even one'. Furthermore, the experiment included 36 fillers, each of them an uncontroversially grammatical or ungrammatical sentence. All the fillers had their complexity comparable to the items.

60 Czech native speakers took part in the experiment which was run online on IBEX. 3 participants were excluded from the analysis due to their unreliable behavior in distinguishing good and bad fillers.[3]

3.2. Experiment 2

The second experiment also tested NR and NPI licensing in Czech. It consisted of two experimental methods – an acceptability and an inference task. For the topic of the current paper only the data from the acceptability part matter (for details of the whole Experiment 2 see Dočekal and Dotlačil 2016). In the acceptability test participants judged acceptability of *ani jeden* 'even one' and *až do* 'until'. The acceptability was judged on the 5-point Likert scale (5=best, 1=worst), as in the other experiment. 5 different environments were used in the experiment (Condition: ENVIRONMENT):

(a) simple positive sentences;

(b) simple negative sentences;

(c) clauses embedded under negated NR predicates of intention and judgment/obligation;

(d) clauses embedded under negated NR predicates of opinion;

(e) clauses embedded under negated non-NR predicates.

[3] On average, pariticipants judged grammatical fillers as better than ungrammatical ones by more than 2 points difference on the 5-point scale (the mean of the difference between judgements on good and bad fillers was 2.21) and every participant (apart from the three excluded ones) showed at least a 1-point difference. The mean difference between good and bad fillers for the three excluded participants was smaller than 1 point (0.62, 0.37 and 0.15). Since they reported much weaker sensitivity to grammatical/ungrammatical sentences, they were not used for further analyses.

In the conditions (c), (d) and (e) strict NPIs and ESDs were placed in embedded clauses. One item for all conditions is shown in (13).

(13) a. Ztratila se ani jedna ovce.
lost SE even one sheep
'A single sheep is missing.'

b. Neztratila se ani jedna ovce.
neg-lost SE even one sheep
'Not a single sheep is missing.'

c. Nový bača v Tatrách nechce, aby se ztratila ani jedna ovce.
new shepherd in Tatras neg-wants C-SUBJ SE lost even one sheep.
'The new shepherd in the Tatra mountains does not want a single sheep to be missing.'

d. Nový bača v Tatrách si nemyslí, že se ztratila ani jedna ovce.
new shepherd in Tatras SI neg-think C-IND SE lost even one sheep
'The new shepherd in the Tatra mountains does not think that a single sheep is missing.'

e. Nový bača v Tatrách neříká, že-IND se ztratila ani jedna ovce.
new shepherd in Tatras neg-say C SE lost even one sheep
'The new shepherd in the Tatra mountains does not say that a single sheep is missing.'

The second manipulation was the type of negative expression. As in Experiment 1, either the strict NPI *ani jeden* 'even one' or *až do* 'until' was used. There were 40 items in total: 20 items appeared with the strict NPI 'even one' and other 20 items used the ESD 'until'. The experiment also included 30 fillers. The experiment was run on IBEX and 60 Czech native speakers participated in it.

Both experiments were filled out by students of Masaryk University and volunteers. While we do not know whether there were people participating in both experiments, we note that there was more than half a year break between the two experiments. Furthermore, different university classes were asked to participate in the two experiments, making it unlikely that the same participant was tested more than once.

4. Results

The results of Experiment 1, revealing the effect of mood and predicate type, are visualized in Figure 1.[4]

We analyzed the Experiment 1 using mixed-effects ordered probit models with two fixed effects: MOOD (indicative vs. subjunctive, the former being the reference level), PREDICATE (opinion (NR), probability (NR) and communication/causative (non-NR), the first one being the reference level), and their interaction. The model furthermore included intercept-only subject and item random effects. We found the following:

[4]Notice that the graph focuses on just a slice of the response scale (from 2.0 to 2.7), to make the contrast more transparent.

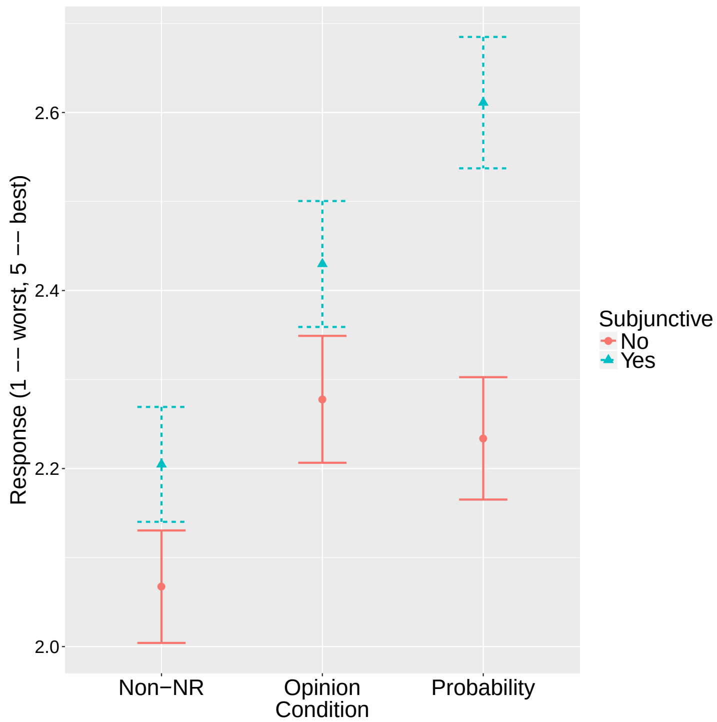

Figure 1: Experiment 1, means and standard errors for three predicates crossed by the subjunctive/indicative mood manipulation

1. NR predicates were judged as significantly better than non-NR predicates ($\beta = -0.22, z = -2.51, p = 0.012$). Recall that the acceptability was mostly influenced by the ESDs/NPIs and their licensing by the three types of predicates interacting with the mood.

2. There was no difference between the opinion and probability class of NR predicates.

3. The subjunctive mood acted as a facilitating factor in the acceptability: ESDs/NPIs embedded in subjunctive clauses were more acceptable than the ones embedded in indicative clauses: $\beta = 0.2, z = 2.39, p = 0.017$.

To study the effect of NPI type, we considered a second model, which added another fixed effect: NEGATIVE EXPRESSION ('even one' and 'until', the former being the reference level) and the interaction of this factor with MOOD and PREDICATE. The new model had a significantly better fit than the previous one (Likelihood ratio test, $p < .001$). The model revealed that ESDs 'until' were generally more acceptable than strict NPIs 'even one' ($\beta = 0.4, z = 2.65, p = .008$). The improvement was further strengthened in the case of probability predicates (there was a significant probability $\times$ 'until' interaction in the positive direction, $\beta = 0.48, z = 2.79, p = 0.005$).

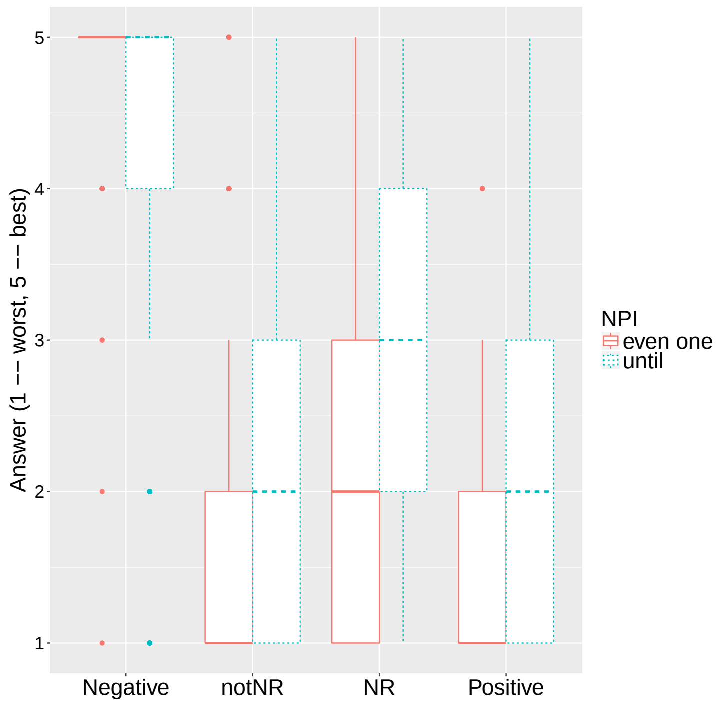

Figure 2: Experiment 2

The graphical summary of the second experiment is presented in Figure 2.[5] Recall that there were 5 environments tested in Experiment 2: NPIs/ESDs in simple positive clauses, in simple negative clauses, in clauses embedded under negated intention/judgment NR predicates, in clauses embedded under negated opinion NR predicates and in clauses embedded under negated non-NR predicates. To study the effect of these environments, we considered a mixed-effects ordered probit model with one factor, ENVIRONMENT (NR predicates of intention/judgment type were the reference level). The model also had the intercept+slope subjects and items random effects. The model showed that intention/judgement NR predicates were significantly worse than simple negative sentences ($\beta = 3.2, z = 7.3, p < .001$), and significantly better than positive sentences ($\beta = -1.5, z = -9.2, p < .001$). They were also significantly better than NPIs/ESDs embedded under non-NR predicates ($\beta = -0.8, z = -5.6, p < .001$), while there was no difference between two types of NR predicates (intention/judgement vs. opinion) ($p > .1$). The difference between NR and non-NR predicates seems stable – it was significant in both experiments, and we interpret it as showing that Czech has a class of neg-raising predicates, contra Bošković and Gajewski (2009) (see Dočekal and Dotlačil 2016 for the same point and more details).

To study the difference between the NPI 'even one' and the ESD 'until', we ran a second model, which consisted of the factor ENVIRONMENT, the factor NEGATIVE EXPRESSION (NPI or ESD, the former being the reference level) and their interaction. The model also included the full random structure for subjects and items.

[5]We did not use boxplots to summarize the results of Experiment 1 since the effects of mood are smaller than effects of NPIs and would be almost impossible to observe in such a graphical summary.

Replicating the results of the first experiment, the model yielded a significant effect for ESDs ($\beta = 0.45, z = 2.3, p = 0.02$), showing that 'until' was judged as better than 'even one' in the intention/judgement NR class. The positive effect was even stronger in the opinion class of NR predicates (opinion $\times$ ESD interaction – $\beta = 0.6, z = 2.43, p = 0.02$), as well as in non-NR sentences and positive sentences (non-NR $\times$ ESD interaction – $\beta = 0.6, z = 2.17, p = 0.03$; positive sentences $\times$ ESD interaction – $\beta = 0.89, z = 2.61, p = 0.009$). In our understanding, the positive interaction of 'until' with non-NR predicates and positive sentences shows that ESDs lead to less severe degradation than strict NPIs when appearing outside of their licensing environment. However, this would not explain why 'until' is better than 'even one' when embedded under NR predicates, since NR predicates should license both (cf., Gajewski 2005). It would also not explain the following finding: ESDs were *less* acceptable than NPIs when appearing in simple negative clauses (negative sentence $\times$ ESD interaction – $\beta = -3.92, z = -4.14, p < .001$). The last effect can be also observed in Fig. 2: while 'until' improves acceptability ratings in non-NR, NR and positive sentences compared to 'even one', it is clearly judged as worse than 'even one' in simple negative sentences.

5. Analysis and discussion

There are two main points of the results we want to address:

1. Why does subjunctive mood improve the acceptability of NPIs/ESDs?

2. Why is the ESD 'until' less acceptable than the NPI 'even one' in negative sentences, but more acceptable under NR predicates?

Let's start with the first queston.

We rely on Romoli (2013) and its scalar approach to NR: NR predicates contribute the at-issue meaning (universal quantification over possible worlds) and an excluded middle alternative (EM) implicature – formalized as the second alternative in (14a). Let's illustrate its working on an example: for a NR verb like *believe* EM is intuitively equivalent to subject's opinionatedness – a well-informed experiencer of the verb believes either the embedded proposition p (e.g. that it is raining) or its negation (that it is not raining). Consider now what happens when we interpret the sentence *John does not believe that it is raining*. Romoli, following Chierchia (2013), assumes that sentences come with an exhaustivity operator, EXH, that affirms the proposition and negates the alternatives that do not contradict the proposition (this is a slight simplification – see Romoli 2013 for the full account). Thus, when we combine the EXH operator with the sentence, the resulting meaning is as in (14b). This can be simplified into (14c). Intuitively: if John doesn't believe that it's raining and he's opinionated w.r.t. raining, then he believes it is not raining.

(14) a. $Alt(NR) = \{\lambda p \lambda x.\Box_x[p], \lambda p \lambda x.[\Box_x[p] \vee \Box_x[\neg p]]\}$
b. EXH(John does not believe that it is raining) = $\neg\Box_j p \wedge \neg\neg[\Box_j p \vee \Box_j \neg p]$
where $p =$ it is raining
c. $\Box_j \neg p$

The scalar theory of NR explains the acceptability of both ESDs and strict NPIs under negated NR predicates. For the former, it is crucial that negation creates a durative predicate (see, for example, Krifka 1989, a.o.). Given that it does and that the negation is interpreted on the embedded predicate, it suffices for the ESD 'until' to modify such a negated predicate to be licensed. For the latter, assume that strict NPIs are licensed in anti-additive environments (Zwarts, 1998). Then, they will be licensed when embedded under NR predicates. Somewhat more technically, since (15) is valid, strict NPIs are licensed under NR predicates. For more details, see Gajewski (2005).

(15) $\Box_x \neg p \wedge \Box_x \neg q \Leftrightarrow \Box_x \neg (p \vee q)$

But why would subjunctives facilitate licensing of strict NPIs/ESDs? We follow Villalta (2008) in her description of the subjunctive mood in embedded sentences as a transferer of alternatives into matrix clauses. According to Villalta, indicative mood, unlike subjunctive, stops such a transfer.

The observed effect of subjunctive follows from this approach. If alternatives can be transferred to the NR predicate, they can be computed. However, if they are not transferred (because they are stopped at the left periphery of the embedded sentence by the indicative mood), the exhaustification of the EM alternatives cannot proceed and the scope of the negation remains high. In this respect, Slavic languages reveal the dependency of NR interpretation on the availability of alternatives, which in turn supports the implicature approach to NR. The presuppositional approach (Gajewski, 2005) to NR would have to make some further assumptions to describe this type of dependency. The effect of mood could also be captured by syntactic accounts of NR (Collins et al., 2014), as subjunctives are generally more transparent for movement (Progovac, 1993).

We now turn to the second question: why do the ESD 'until' and strict NPI 'even one' differ from each other? First, notice that 'until' in Czech shows different scopal behavior than NPIs. NPIs generally cannot c-command their licensors (De Swart, 1998), see (16). Surprisingly, the reverse is true for the ESD 'until': while it is degraded in (17a) it improves when *až do půlnoci* 'until midnight' precedes/outscopes negation, (17b).

(16) a. Phil would not give me anything.
b. *Anything Phil would not give me.
(from De Swart 1998, ex. 8)

(17) a. ??Petr neusnul až do půlnoci.
Petr neg-fell-asleep up to midnight
'Petr didn't fall asleep until midnight.'
b. Až do půlnoci Petr neusnul.
up to midnight Petr neg-fell-asleep
'Until midnight Petr didn't fall asleep.'

In our experiment we used items with ESDs linearized after negated verbs (which is the default adverb placement), as illustrated in (18) (the simple negative condition).

(18) Vojáci se nevystřídají až do půlnoci.
soldiers SE neg-exchange up to midnight
'The soldiers will be not exchanged until midnight.'

Remember, that in such sentences ESDs were considered worse than strict NPIs. Changing the linearization seems to improve the acceptability of (18) considerably (although we lack a proper experimental support for our intuitions in this case). But recall that if *až do* 'until' would be an NPI, this effect would be totally unexpected. If anything, we would expect an opposite effect. This strongly suggests to us that *až do* 'until' is *not* a strict NPI (in contrast to what is commonly assumed about its English counterpart). More concretely, since Czech is a language in which arguments/adjuncts are often interpreted in their surface position (i.e., QR is much less common than in English), the ESD 'until' is interpreted as a modifier of the (non-negative) VP when appearing after the verb. This VP is punctual and thus, it cannot satisfy the requirement of 'until'. The change in linearization as in (17b) allows a different parse, one in which 'until' modifies the negated event, hence the improved acceptability of the ESD in this case.

But why would 'until' be more acceptable (as compared to the strict NPI 'even one') when modifying punctual predicates embedded under NR predicates? One explanation could go as follows. Negation is interpreted in the embedded clause at the logical form via pragmatic mechanisms. Since it is not syntactically present there, there is no signal from syntax whether the 'until' modifier should be interpreted in its scope or above it. In other words, there is no evidence from syntax that would support either interpretation. Given that, readers are free to pick the interpretation that is more suitable – and that is the one in which the ESD is interpreted above negation and the condition of the ESD is satisfied. Notice that this does not predict that ESDs should be better under NR predicates than in simple negative clauses. If the strengthening to EM is marginal to begin with (as Dočekal and Dotlačil 2016 argue), ESDs might be still less acceptable in this case than in simple negative clauses. What is (correctly) predicted is a relative difference: ESDs should be less acceptable than strict NPIs in simple negative clauses, but this difference should disappear in clauses embedded under NR predicates. Since ESDs are generally less degraded when lacking their licensor, compared to strict NPIs (as witnessed by the fact that ESDs are more acceptable than strict NPIs in positive sentences and clauses embedded under non-NR predicates), we furthermore expect that under NR predicates, ESDs should not just be as good as strict NPIs, but in fact, even more acceptable than strict NPIs – and this is correct.

6. Conclusion

We discussed two experiments that studied the licensing conditions of two expressions in Czech: *ani jeden* 'even one' and *až do* 'until'. English counterparts of these expressions are often treated as belonging to the same class, that of strict NPIs (Gajewski 2005 and references there). However, our experiments revealed subtle differences between the two expressions, which we argued could be explained if we assume that only *ani jeden* 'even one' is a strict NPI, while *až do* 'until' is an expression sensitive to durativity of the predicate it modifies. Aside from that, we also saw that Czech reveals effects of mood in licensing both *ani jeden* 'even one' and *až do* 'until' under NR predicates. The role of mood on licensing was explained in Romoli's theory of NR. Both points show that experimental work on languages less often studied (from the perspective of formal semantics) can clearly enrich our current understanding of language variation and interpretation.

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Focus association by movement: Evidence from binding and parasitic gaps[1]

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Abstract. Under the influential Roothian proposal for focus association, focused phrases remain in-situ at LF (Rooth, 1985, 1992). However, a recent line of work has resurrected the idea that focus association involves covert movement: specifically, the associate of English sentential *only* must covertly move to *only*, with the possibility of covert pied-piping (Drubig, 1994; Krifka, 1996, 2006; Tancredi, 1997, 2004; Wagner, 2006; Erlewine and Kotek, 2014, 2018). In this paper we contribute to this emerging consensus view with additional evidence from reflexive binding and parasitic gap licensing.

Keywords: focus association, *only*, covert movement, binding, parasitic gaps

1. Two approaches to focus association

The problem of focus association concerns the relationship between focus-sensitive operators such as *only* and focused constituents such as *Fridays* or *chocolate* in (1). The semantics of *only* quantifies over the focused constituent and its contextual alternatives: for example, (1a) asserts that there is no day other than Friday where John eats chocolate, whereas (1b) asserts that John eats nothing other than chocolate on Fridays (see e.g. Horn, 1969).

(1) a. John only eats chocolate on $[\text{Fridays}]_\text{F}$.
 b. John only eats $[\text{chocolate}]_\text{F}$ on Fridays.

How does *only*'s semantics make reference to this focused constituent? One family of approaches posits the existence of *covert focus movement* so that the focused constituent becomes a local argument of the *only* operator at LF. A sample LF for example (1b) under the covert focus movement view is given in (2) below. Here we illustrate the non-quantificational subject *John* in its VP-internal base position. The movement in (2) makes the focus *chocolate* a local argument of a two-place *only* operator.[2]

(2) **Covert movement LF for (1b):**
 only $\big([\text{chocolate}]_\text{F}\big)$ $\big(\lambda x$. John eats x on Fridays$\big)$

The alternative approach — popularized by Rooth (1985, 1992) and adopted in much contemporary work on focus semantics — assumes that focused constituents remain in-situ at LF. The operator (*only*) makes indirect reference to the choice of focus and its alternatives through a process of *alternative computation*. Each syntactic node α is associated not only with its ordinary semantic denotation $[\![\alpha]\!]^o$ but also with a set of alternatives, $[\![\alpha]\!]^f$, defined recursively as in (3) below. Focused (F-marked) constituents introduce non-trivial alternatives into their focus-

[1]We thank Aron Hirsch and anonymous reviewers for comments on the material here. Errors are each other's.
[2]The precise geometry of this movement could vary. See footnotes 7 and 8 in Erlewine and Kotek (2018) for detailed discussion of this movement and alternative formulations.

alternative denotations (3c), which are then propagated up through the process of *pointwise composition* (3b).

(3) **Focus alternative computation:**
a. For non-focused terminal nodes:
$[\![\alpha]\!]^f = \{[\![\alpha]\!]^o\}$
b. For non-focused branching nodes (pointwise composition):
$[\![[\alpha\,\beta]]\!]^f = \left\{a \circ b \;\middle|\; a \in [\![\alpha]\!]^f,\, b \in [\![\beta]\!]^f\right\}$
where $\circ$ is the appropriate composition operation for $[\![\alpha]\!]^o$ and $[\![\beta]\!]^o$.
c. For focused nodes:
$[\![\alpha]\!]^f$ is a contextually-determined subset of D_τ where τ is the type of $[\![\alpha]\!]^o$

The result of this procedure is that the contextual alternatives to *chocolate* in (4b) will be reflected indirectly in the set of alternatives at VP (4c), which is a local argument of *only*.

(4) **Interpreting (1b) with focus in-situ:**
a. only [$_{\text{VP}}$ John eats [chocolate]$_\text{F}$ on Fridays]
b. $[\![\text{[chocolate]}_\text{F}]\!]^f$ = {chocolate, fish, pizza, ...}
c. $[\![\text{VP}]\!]^f = \left\{\begin{array}{l}\text{John eats chocolate on Fridays,}\\ \text{John eats fish on Fridays,}\\ \text{John eats pizza on Fridays, ...}\end{array}\right\}$
d. [only VP] $\Rightarrow$ John doesn't eat fish on Fridays,
John doesn't eat pizza on Fridays, ...

As an empirical argument for the in-situ view, Rooth (1985) following Anderson (1972) notes that focus association is apparently insensitive to syntactic islands. For example, in (5) based on an example from Kratzer (1991), *only* successfully associates narrowly with the focused constituent *the Zoning Board* inside a relative clause island. Under the covert movement approach — so the argument goes — covert movement of *the Zoning Board* should be impossible, just as the corresponding overt focus movement in (6) is ungrammatical.[3]

(5) **Focus association is apparently island-insensitive:**
I only contacted [$_{\text{island}}$ the person who chairs [the Zoning Board]$_\text{F}$].

(6) **Corresponding overt focus movement of *the Zoning Board*:** (Kratzer, 1991: 831)
* It was [the Zoning Board]$_\text{F}$ that I contacted [$_{\text{island}}$ the person who chairs ___].

Drubig (1994) however notes that this island-sensitivity problem can be avoided if covert focus movement can trigger *pied-piping*. That is, instead of the logically focused constituent moving alone to become a local argument of *only*, a *focus-containing phrase* can instead move to *only*. This possibility is illustrated schematically for the case of example (5) in (7) below.

[3] A possible response may be to say that covert (focus) movement is not sensitive to the same island constraints as overt movement, but this is ultimately incorrect. See Wagner (2006) and Erlewine and Kotek (2016, 2018) for evidence that covert focus movement *is* sensitive to syntactic islands.

(7) **LF for (5) using covert focus movement with pied-piping:**
only $\big($[$_{\text{island}}$ the person who chairs [the Zoning Board]$_{\text{F}}$]$\big)$ $\big(\lambda x$. I contacted $x\big)$

The interpretation of the pied-piped constituent in (7) then must utilize Rooth's mechanism of in-situ alternative computation in order to yield the observed sensitivity to the position of focus within the pied-piped phrase. Pied-piping of the constituent in (7) is also independently observed in overt focus movement, as in example (8):[4]

(8) **Corresponding overt focus movement with pied-piping:** (cf (6))
✓ It was [$_{\text{island}}$ the person who chairs [the Zoning Board]$_{\text{F}}$] that I contacted ___.

This hypothetical possibility of pied-piping in covert focus movement thus defuses Rooth's argument from island-insensitivity for the in-situ approach to focus association. Independent evidence is then necessary to adjudicate between these two possible options. A series of works in the past decade have introduced new arguments for the idea that focus association with English *only* necessarily involves covert focus movement with the possibility of covert pied-piping.[5] The gist of each of these arguments is summarized here in (9).

(9) **Previous arguments for covert focus movement with pied-piping:**

a. Krifka (2006): Restrictions on association of *only* with multiple foci are sensitive to islands, in a manner predicted by the covert movement with pied-piping view.

b. Wagner (2006): The distribution of NPIs licensed by adverb *only* is sensitive to the placement of islands, in a manner predicted by covert movement with pied-piping.

c. Erlewine and Kotek (2014): The distribution of *focus intervention effects* (Beck, 2006) in focus association is explained by covert focus movement with pied-piping, with intervention affecting just the covertly pied-piped material.

d. Erlewine and Kotek (2016, 2018): The distribution of so-called *Tanglewood* configurations, where alternatives apparently co-vary between a pronounced focus and within an ellipsis site (Kratzer, 1991), is sensitive to syntactic islands. Tanglewood readings are best explained using covert focus movement with pied-piping.

In this paper, we contribute two new arguments to this growing body of evidence. Following related diagnostics for covert *wh* movement by Nissenbaum (2000a, b), we will show that covert focus movement in English can feed reflexive binding and the licensing of parasitic gaps. These effects too are unexplained by the in-situ approach to focus association.

[4]In some cases, however, the pied-piping that we would need to posit for covert focus movement may be larger than what is observed with overt pied-piping. There is however independent evidence that pied-piping can be larger with covert movement than with overt movement: see Kotek and Erlewine (2016).

See also Horvath (2000, 2007) for discussion of pied-piping in overt focus movement.

[5]All of these works in (9) look exclusively at focus association with English sentential *only*. A significant open question is whether this claimed necessity of covert movement in focus association extends to other focus-sensitive operators or languages.

2. Binding

Nissenbaum (2000b: pp. 124ff) shows that covert *wh*-movement in English allows reflexives to be bound by an antecedent outside of their surface local binding domain: that is, covert phrasal movement feeds reflexive binding. Consider the contrast in (10):

(10) **Covert *wh*-movement feeds reflexive binding:** (Nissenbaum, 2000b: p. 126)
 a. * Who$_i$ thinks [Mary was looking at a picture of himself$_i$]?
 b. Who$_i$ thinks [Mary was looking at *which picture of himself$_i$*]?

The masculine reflexive *himself* does not have a local antecedent within the embedded clause, as the ungrammaticality of the baseline (10a) indicates. However, when this reflexive is contained within an in-situ *wh*-phrase, it can be bound by a higher antecedent, as long as the containing *wh*-phrase takes scope under the antecedent. In this case, assuming that movements triggered by the same head (here: matrix C) will "tuck in" (see also Richards, 1997; Pesetsky, 2000), (10) will have a LF representation as in (11).[6]

(11) **Covert *wh*-movement LF for (10):**
 [$_{\text{CP}}$ Who$_i$ [which picture of himself$_i$] [$_{\text{TP}}$ __ thinks [$_{\text{CP}}$ Mary was looking at __]]

In this higher LF position, *himself* is close enough to the intended antecedent, *who*. We therefore conclude that Binding Condition A is evaluated at LF.

We can similarly use reflexive binding to test whether or not focused material — or material pied-piped together with focused material — can include reflexives bound by a higher antecedent than regularly possible, as long as it is within the scope of the associating *only*. We begin with the baseline in (12), where the intended antecedent of *myself* is the matrix subject, outside of the relevant binding domain (BD).

(12) Baseline: *I want [$_{\text{BD}}$ the museum to display a picture of myself].

Now consider example (13), which differs minimally from (12) in the addition of *only* above *want*, associating with the F-marked *picture*. The reflexive *myself* is now successfully bound by its intended antecedent, which is outside of *myself*'s surface local binding domain (cf (12)).

(13) **Covert focus movement feeds reflexive binding:**
 Context: I commissioned many paintings and pictures of myself. The museum is interested in displaying both a painting and a picture that I had made, but in fact,
 ✓ I only want [$_{\text{BD}}$ the museum to display [a [picture]$_{\text{F}}$ of myself]].

The grammaticality of the reflexive binding in (13) is explained by the availability of covert focus movement with pied-piping. The proposed LF for (13) is given in (14). Here the overt

[6] Following Kotek (2016), this covert *wh*-movement need not always move all the way up to the interpreting complementizer, but it suffices here that, in (10b) but not (10a), attraction of the surface in-situ *wh*-phrase has the option of covertly moving out of the embedded clause.

A-movement of the subject from its predicate-internal position to its surface position, above *only*, is critical and therefore illustrated.

(14) **LF for (13) using covert focus movement with pied-piping:**
$\mathrm{I}_i\ \lambda y$. only([a [picture]$_\mathrm{F}$ of myself$_i$]) (λx . y want [$_\mathrm{BD}$ the museum to display x])

If a different constituent is focused which will not trigger covert movement of the reflexive, the long-distance binding in (13) is not licensed:

(15) * I only want [$_\mathrm{BD}$ the [museum]$_\mathrm{F}$ to display a picture of myself].

Notice that the solution here is not to simply say that focused constituents themselves can violate locality in reflexive binding: what is focused in (13) is *picture*, not *myself*. It is necessary for covert focus movement of the F-marked constituent, *picture*, to trigger pied-piping of the whole reflexive-containing DP, *a picture of myself*.

Note too that it is not simply the case that focus on the head noun *picture* in (13) somehow allows *myself* to be bound long-distance, by an antecedent outside of the surface binding domain (BD). This long-distance binding facilitated in (13) is limited to the scope of *only*. If we attach *only* lower, within the surface binding domain of the reflexive, the long-distance antecedent option disappears:

(16) * I want [$_\mathrm{BD}$ the museum to only display a [picture]$_\mathrm{F}$ of myself].

To summarize, we find that association with *only* feeds reflexive binding, as would be predicted by a theory of covert movement with pied-piping: the F-marked constituent moves (possibly with pied-piping) to become the first argument of *only*. This movement can put this constituent in a local relationship with a binder that is otherwise absent, licensing a binding relation. This result is unexpected under an in-situ account of Association with Focus, which predicts no difference between (12) and (13).

3. Parasitic gap licensing

The literature on parasitic gaps has largely followed Engdahl (1983) in assuming that *wh*-in-situ never licenses parasitic gaps. Engdahl's examples are reproduced in (17) below. Assuming that in-situ *wh*-phrases must or can move covertly (Karttunen, 1977; Huang, 1982; Pesetsky, 2000; Kotek, 2016; a.o.), this claim is commonly (re)interpreted as a claim that covert movements cannot license parasitic gaps.

(17) ***Wh*-in-situ does not license parasitic gaps:** (Engdahl, 1983: p. 14)
  a. * John filed *which articles* without reading $\underline{\ \ _{pg}\ \ }$?
  b. * Who filed *which articles* without reading $\underline{\ \ _{pg}\ \ }$?

Nissenbaum (2000a, b) shows that Engdahl's generalization is not exceptionless: although it is true that covert movement *alone* does not license parasitic gaps, overt movement together with covert movement through the same *v*P edge can together license *two* parasitic gaps. An in-situ *wh*-phrase can license a *secondary parasitic gap* (18), which is not simply licensed by the presence of a non-*wh* phrase in the same position (19).

(18) ***Wh*-in-situ licenses a *secondary* parasitic gap:** (Nissenbaum, 2000a: p. 542)
Which senator$_i$ did you persuade ___$_i$ to borrow *which car*$_j$
[after getting an opponent of $\underline{\;pg\;}_i$ to put a bomb in $\underline{\;pg\;}_j$]?

(19) * *Which senator*$_i$ did you persuade ___$_i$ to borrow a Prius$_j$
[after getting an opponent of $\underline{\;pg\;}_i$ to put a bomb in $\underline{\;pg\;}_j$]?

It is also possible to license an adjunct with just one parasitic gap bound by the overtly-moved *wh*-phrase (20a), but not with one corresponding to the in-situ *wh*-phrase (20b). The main clauses in both examples here are identical to that in (18). The secondary parasitic gap pg_j as in (18) is, then, itself parasitic on the first parasitic gap pg_i which corresponds to the overtly moved *wh*-phrase.

(20) **Secondary parasitic gap is parasitic on the first parasitic gap:**
a. *Which senator*$_i$ did you persuade ___$_i$ to borrow *which car*$_j$ (*Ibid.* p. 552)
[after talking to $\underline{\;pg\;}_i$ for an hour]?
b. * *Which senator*$_i$ did you persuade ___$_i$ to borrow *which car*$_j$
[after putting a bomb in $\underline{\;pg\;}_j$]?

To license the adjunct with two parasitic gaps, both the overt and covert $\bar{\text{A}}$-movement steps must cross the same *v*P edge. This is accomplished in (18) at the *v*P edge associated with *persuade*, as *which senator* is overtly $\bar{\text{A}}$-moved from within it. Subjects which are first A-moved out of *v*P do not license their own parasitic gaps (Engdahl, 1983; a.o.) and similarly do not license secondary parasitic gaps:

(21) * *Which terrorist*$_i$ ___$_i$ persuaded the senator to borrow *which car*$_j$
[after getting a friend of $\underline{\;pg\;}_i$ to put a bomb in $\underline{\;pg\;}_j$]?

The correct generalization regarding the licensing of parasitic gaps by covert movement is then as in (22). Nissenbaum (2000a, b) gives an explanation for this generalization in terms of the derivational timing of overt vs covert movement and adjunction of the parasitic-gap-containing adjunct. We refer interested readers to those works.

(22) **The Engdahl/Nissenbaum generalization:**
Covert $\bar{\text{A}}$-movement by itself does not license parasitic gaps. However, covert $\bar{\text{A}}$-movement does license a secondary parasitic gap when it crosses a *v*P edge that is also crossed by an overt $\bar{\text{A}}$-movement step.

We now show that focus association with *only* also licenses secondary parasitic gaps, as predicted by the covert focus movement approach to Association with Focus. Example (23) below is based on the ungrammatical baseline (19) above, but with the addition of an *only* associating with the object of *drive* — here, *a Jaguar*:

(23) **The focus associate of *only* licenses a secondary parasitic gap:**
✓ *Which senator$_i$* could you only persuade ___$_i$ to drive [a [Jaguar]$_F$]$_j$
[after getting an opponent of $\underline{pg}_i$ to put a bomb in $\underline{pg}_j$]?

Both the overt movement of *which senator* and the covert movement of *a Jaguar* to *only* in (23) will cross through the *v*P edge associated with *persuade*, to which the *after*-adjunct adjoins. If *only* is introduced lower so that the path of covert focus movement does not overlap with the overt *wh*-movement path, as in (24), the secondary parasitic gap becomes ungrammatical, as also predicted by the generalization in (22).

(24) **The position of *only* marks the height of covert focus movement:**
* *Which senator$_i$* could you persuade ___$_i$ to only drive [a [Prius]$_F$]$_j$
[after getting an opponent of $\underline{pg}_i$ to put a bomb in $\underline{pg}_j$]?

Just as we saw with *wh*-movement, parasitic gap licensing by covert focus movement is only possible when crossing a *v*P edge that is also crossed by overt $\bar{\text{A}}$-movement, as per the Engdahl/Nissenbaum generalization (22). The generalization also predicts that a single parasitic gap is not licensed by the covertly moved focus of *only* alone. This prediction is borne out in (25):

(25) **Covert focus movement alone does not license parasitic gaps, as predicted by (22):**
a. * I only criticized [[this]$_F$ book] without reading $\underline{pg}$.
b. * I only want to read [[this]$_F$ book] without buying $\underline{pg}$.

We include another set of secondary parasitic gap contrasts, similar to the examples above. Example (26a) shows the ungrammaticality of a secondary parasitic gap with a referential DP, *the placebo*; example (26b) shows the availability of a secondary parasitic gap with a *wh*-phrase in that position; and (26c) shows the parallel licensing of a secondary parasitic gap with an *only* associating with a focused *placebo*.

(26) a. * *Which patients$_i$* did the doctors assign ___$_i$ to the placebo$_j$
[after showing the families of $\underline{pg}_i$ how to administer $\underline{pg}_j$]?
b. *Which patients$_i$* did the doctors assign ___$_i$ to *which drug$_j$*
[after showing the families of $\underline{pg}_i$ how to administer $\underline{pg}_j$]?
c. Context: Following FDA regulations, patients' families were shown how to administer all the drugs that might be associated with the trial. After some patients began exhibiting unexpected symptoms, the families wrote the FDA and demanded to know:
Which patients$_i$ did the doctors only assign ___$_i$ to [the [placebo]$_F$]$_j$
[after showing the families of $\underline{pg}_i$ how to administer $\underline{pg}_j$]?

In examples (19) and (26a), the secondary parasitic gap is not licensed. The presence of the secondary parasitic gap is not by itself able to force the covert movement necessary to license the gap. Instead, this movement must be independently licensed — covert *wh*-movement in (18) and (26b) and covert focus movement in (23) and (26c).

We conclude that — like in the case of covert *wh*-movement — parasitic gaps on F-marked material are licensed in Association with Focus constructions. This is predicted if association with *only* requires covert focus movement but is unexplained by the common, in-situ association approach of Rooth (1985) and others.

4. Conclusion

Evidence from reflexive binding and parasitic gap licensing shows that the focus associate of *only* is interpreted in a higher position at LF through covert movement. This is predicted under the covert movement theory of *only*, where the F-marked constituent moves (possibly with pied-piping) to become the first argument of a two-place *only* (Drubig, 1994; Krifka, 1996, 2006; Tancredi, 1997, 2004; Wagner, 2006; Erlewine and Kotek, 2014, 2018). It is inconsistent with the influential in-situ analysis of association with *only* (Rooth, 1985, 1992), and hence serves as an argument against this view.

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Subjective standard-setting in gradable predicates: On the Mandarin *hen* structure[1]

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Abstract. Canonical positive degree sentences in Mandarin Chinese are formed with a morpheme *hen*. In the literature, this morpheme is regarded as the positive degree morpheme *pos* (Kennedy, 1999; Liu, 2010; Grano, 2012; Zhang, 2015) that introduces a contextually given norm, as well as binding the degree argument. However, the traditional *pos* analysis cannot fully account for some behaviors of *hen*. First, *hen* sentences share several characteristics of subjective predicates like Predicates of Personal Tastes (PPTs). These features include the triggering of faultless disagreement and embedding under perceptual verb *ganjue* and *ganjue-dao* 'feel/find'. Furthermore, when compared with other adjectival expressions, the *hen* form makes a weaker statement, which is related to the speaker's subjective belief. To account for these two characteristics, I propose that *hen* introduces a subjective standard determined by a judge that is based on a subjective epistemic knowledge state.

Keywords: degree semantics, gradable adjectives, positive degree sentences, subjectivity, Mandarin Chinese

1. Introduction

This work focuses on a type of Mandarin adjectival sentence, the *hen* sentence, which has the basic structure like (1). It unique in that there is an obligatory morpheme *hen* that appears before the adjective.

(1) Afu hen gao
Afu HEN tall
'Afu is tall.'

It is hard to pinpoint the meaning of *hen*. By some native speakers' intuition, this particle is a dummy marker in the sentence. Yet other speakers might think that it also means *very*, which indicates that the degree is high. Because of these features, *hen* is often regarded as the overt realization of positive degree morpheme, *pos* (see von Stechow, 1984; Kennedy, 1999, 2005, 2007, among many others, on *pos*). *Pos* has two functions. It introduces a contextually given standard, and the degree of the sentence exceeds this standard significantly. Second, gradable adjectives takes a degree argument, *pos* binds this argument to avoid type mismatches when combined with the subject. The lexical entry of *pos* is given in (2). The function *s* here is a contextually sensitive function that takes a gradable adjective *g* and returns a corresponding standard. An example of the derivation is given in (3).

(2) $[\![pos]\!]=\lambda g\lambda x.\ g(x) > s(g)$ (Kennedy, 2007)

[1] I would like to thank Roumyana Pancheva, Barry Schein, Andrew Simpson, Audrey Li, Robin Jesheon, who gave me valuable comments on an early version of this work. I'd also like to thank Thomas Grano, Alexis Wellwood, and the audience at Sinn und Bedeutung 21, and also the audience from WCCFL 34, who helped me to develop my work from my previous presentation there. All remaining errors are my own responsibility.

(3) $[\![pos \text{ expensive}]\!] = \lambda d \lambda x.\text{expensive}(x) \geq s(g)$
Meaning: the degree of expensiveness exceeds a contextually given degree.
Implication: The degree of expensiveness stands out among a comparison class.

The advantage of this analysis is straightforward. It explains why *hen* is obligatory with gradable adjectives, and it also accounts for certain parallels of *hen* sentences with positive degree sentences in English. For example, the degree of the sentence should not only exceed the standard, but it should be significant enough for the subject to stand out among the objects in a comparison class. Therefore, *John is tall* implies that John's height not only exceeds a certain norm for tall people, but it also is significant enough to 'stand out' among them. As a support for the *pos* analysis of *hen*, this feature might be able to explain why some native speakers have an intuition that *hen* is similar to *very*, which also implies the degree to be significant.

However, there are several features of *hen* that cannot be accounted for directly by viewing it as *pos*. The first one is related to the subtypes of gradable adjectives that *hen* can occur with, and the different meanings they trigger, followed by problems that emerge when compared with another adjectival form, the *shi…-de* form. Second, contrary to previous analyses, *hen* is only obligatory when the sentence is uttered out of the blue. When there is an existing standard from the context, it can be dropped. The *hen* form is also weaker than the expression where *hen* is dropped. Third, *hen* predicates are licensed by a negation form *mei* that only selects eventive predicates. Finally, *hen* shows certain features that are parallel to subjective predicates, such as *Predicates of Personal Tastes* (PPTs). These properties can be accounted for if one sees *hen* as related to a subjective standard determined by a judge's knowledge state. In the following sections, I start by discussing the first three problems in section 2, and then move on to discuss the subjective features of *hen* predicates in section 3. In section 4, I discuss the characteristics of the subjectivity of *hen*. In section 5, I provide an analysis for the *hen* sentences, which is similar to Fernald's view on verbs like *appear* and *seem* (Fernald, 2000). Section 6 concludes this work.

2. Problems with the *pos* analysis

2.1. *Hen* with absolute adjectives

Gradable adjectives can be classified into two major classes, *relative adjectives* and *absolute adjectives* (Kennedy and McNally 2005). They are distinguished according to whether the scales they correspond to are bounded or open. As scales are set of ordered degrees, if a scale has no minimal or maximal degrees, it is an open scale. If it has maximal or minimal degrees, it is a closed scale. For example, the adjective *tall* corresponds to a scale of height, and there is no maximal or minimal degree for height. Adjectives with an open scale are relative adjectives. Some examples are given in (4).

Relative adjectives:
(4) Open scales: the standard is contextually restricted
Gao, 'tall', *pang* 'fat', *chang* 'long', *kuan* 'wide', *shuai* 'handsome'

In contrast, adjectives corresponding to closed scales are absolute adjectives. They can be further classified into three types, upper-closed scales, which have a maximal degree but no minimal degree, lower-closed scales, which have only a minimal degree, and totally closed scales, which have both minimal and maximal degrees. The examples are given in (5). I assume that the same categorization works for Mandarin as well.[2]

Absolute adjectives:

(5) a. Upper-closed scales: **standard=degree$_{max}$**
gan 'dry', *ganjin* 'clean', *ping* 'flat', *zhi* 'straight'
b. Lower-closed scales: **standard=degree$_{min}$**
shi 'wet', *zan* 'dirty'
c. Totally-closed scales: **standard=degree$_{max}$**
man 'full', *xing* 'awake', *touming* 'transparent', *kai* 'opened', *kandejian* 'visible'

In English, when an absolute adjective has a maximal degree, which include upper-closed scale and totally-closed scale adjectives, the standard is set at the maximal degree. A lower-closed scale has only a minimal degree, and the standard is set at this degree.

While both positive degree sentences with absolute and relative adjectives in English use the same form, Mandarin Chinese actually grammaticalizes this distinction. The *hen* form is only the default form for relative adjectives, as shown in (1), while the canonical positive form for absolute adjectives is the *shi…-de* form. *Shi* is the main copula in Mandarin Chinese, and *–de* is a modifier marker. The *shi…-de* form is also the predicative form for non-gradable adjectives, as in (9).

Upper-closed scales: standard=d$_{max}$

(6) Wazi shi gan-de
sock COP dry-DE
'The sock is dry.'
Implication: The dryness of the sock reaches d$_{max}$

Lower-closed scales: standard=d$_{min}$

(7) Wazi shi shi-de
sock COP wet-DE
'The sock is wet.'
Implication: The sock has at least minimal wetness

Totally-closed scales: standard=d$_{max}$

(8) Beizi shi man-de
cup COP full-DE
'The cup is full.'

[2] The major piece of evidence for this categorization, according to Kennedy and McNally (2005), is from modification by certain degree modifiers. An adjective like *slightly* modifies adjectives with lower bounds. *Completely* takes adjectives with upper bounds. Proportional adjectives, such as *half*, modify adjectives with totally-closed scales. Adjectives in Mandarin Chinese have similar properties. Due to limitations of space, I will not include the examples here.

Non-gradable adjectives

(9) Diqiu shi yuen-xing-de
Earth COP round-shape-de
'The Earth is round.'

The *shi…-de* form can also occur with relative adjectives, but only when there is a known standard given in the context, which sets things into categorical distinctions. Take (10) for example. When the *shi…-de* form is used with *gao* 'tall', it implies that there is an absolute degree that separates objects into those that are tall and those that are not. If being 6 feet tall count as tall, as long as Afu reaches this degree of height, he is a tall person. Afu does not need to 'stand out' in a comparison class, which is distinct from English positive degree sentences.

(10) Afu shi gao-de, Ali bu-shi.
Afu COP tall-DE Ali NEG-COP
'Afu belongs to the category of tall people, while Ali doesn't.'

Quite unexpectedly, *hen* can also co-occur with absolute adjectives. Yet it only means that the degree is rather high, and it does not necessarily reach the absolute standard. It can be anywhere on the scale, as long as it is regarded as high. The sentences in (11) are examples of upper-closed scale adjectives. As shown in (11b), a *hen* sentence does not entail the *shi…-de* form, of which the standard is the maximal degree.

(11) a. Wazi hen shi
sock HEN wet
'The sock is very wet.'
b. Wazi hen gan, dan bu-shi (wanquan) gan-de
sock HEN dry but NEG-COP totally dry-DE
'The sock is very dry, but it is not (completely) dry.'

Likewise, with lower-closed adjectives, the sentence asserts that the degree is significantly high, not just reaching the minimal degree.

(12) Wazi hen shi
sock HEN wet
'The sock is very wet.'
Implication: the reference value is significantly high.

As for adjectives with totally-closed scales, the standard does not need to reach the upper bound, but it is significantly high.

(13) a. Beizi hen man
cup HEN full
'The cup is very full.'
b. Beizi hen man, dan bu-shi (wanquan) man-de
cup HEN full but NEG-COP totally full-DE
'The cup is very full, but it's not totally full.'

What is the difference between the *shi…-de* form and the *hen* form when it comes to absolute adjectives? A possible analysis is that the *shi…-de* form introduces what is known as a *conventional standard* (Kennedy, 2007), while *hen* introduces a contextually given standard, functioning just like *pos*. In English, the traditional analysis of *pos* cannot directly account for why standards for absolute adjectives are set at the bounds. Kennedy (2007) proposes an economy principle, *Interpretive Economy*, which requires the interpretations of a sentence to be based on conventional understanding as much as possible. Since the standards of absolute adjectives are conventionally on the natural bounds, their standards are interpreted on these bounds, unless such interpretations are unavailable.

Take *wet* for example. *Wet* has a lower-closed scale. For an expression *the sock is wet*, it only requires minimal wetness for things to count as wet. As a result, context-dependent standards become last resort, which emerges only when conventional standards are unavailable. It is possible that Mandarin has both types of standards irrespective of the categories of the gradable adjectives. Therefore, the *hen* form derives a standard from a comparison class even with absolute adjectives. Take (13) for example. It would mean that the cup's fullness exceeds a contextually given standard of being full, which is derived from comparing the fullness of this specific cup with other objects filled to different degrees. It does not entail that it reaches the conventional standard, which is the maximal degree. In other words, absolute adjectives now behave just like relative adjectives in standard setting when *hen* is added. This explains why (13b) is not contradictory under the traditional *pos* analysis.

The above analysis, however, faces a problem. If what *hen* introduces is a contextual standard for a thing x to count as having a property P, it would be nearly equivalent to, when expressed under that same context, that x is a P thing. This works for relative adjectives in English. In (14), once the standard for being tall is set through the context, and the girl exceeds that height, she is a girl that has the property of being tall.

(14) That girl is tall. ≈ That girl is a tall girl.

This is not borne out for *hen* sentences with absolute adjectives, as shown in (15). For the sock to be *hen*-dry, it does not need to be dry at all, whether the standard is given contextually or stipulated conventionally. It only implies that the dryness of the sock is significantly high.

(15) Zhe wazi hen gan ≉ zhe wazi shi yi-zhi gan-de wazi.
this sock HEN dry this sock COP one-CL dry-DE sock
'This sock is very dry.' ≉ 'This sock is a dry sock.'

The data presented here seems to suggest that the *hen* form is a weaker statement than the attributive form in (15). Similarly, it is weaker than the *shi…-de* form in (13). In conclusion, the *hen* form is not simply the *pos* counterpart of English, or at least this is not the full picture.

2.2. Comparison with the 'bare' form

A second problem with the *pos* analysis is that *hen* is not obligatory in some marked environments.[3] When a simple sentence is uttered out of the blue, it is infelicitous without *hen*, as in (16).

Out of the blue context:

(16) A: #Afu congming.
Afu smart
'Afu is smart.'

However, *hen* can be omitted when the property denoted by the gradable adjective is regarded as a known fact.

(17) Women dou zhidao, Afu gao.
we all know Afu tall
'We all know, that Afu is tall.'

Furthermore, as pointed out by Liu (2010), *hen* can be omitted under some modals, including factive verbs such as *aonao* 'regret/annoyed' and *zhidao* 'know', and epistemic modals like *renwei*, as shown in (18) and (19).

Factive verbs:

(18) a. Wo aonao ta (hen) wuzhi.
I feel-annoyed s/he HEN ignorant
'I feel annoyed at her/his being ignorant.'
b. Wo zhidao ta (hen) wusi.
I know s/he HEN altruistic
'I know that he is altruistic.' (Liu, 2010)

Epistemic modal *renwei* 'think':

(19) Wo renwei ta (hen) wuli.
I think s/he HEN unreasonable
'I think s/he is unreasonable.' (Liu, 2010)

Based on the analysis that *hen* is the realization of *pos,* Liu proposes that modals, as well as several other structures (see footnote 3), carry an operator that licenses a covert form of *hen*.

However, Liu does not mention a common feature when *hen* is dropped in these sentences. In the bare form, there is always a strong implication that the property denoted by the adjective is already an accepted fact. This explains why the bare form is compatible with factive verbs, which trigger the presupposition that the complement proposition is true. Similarly, with

[3] Liu (2010) points out that there are several structures in which *hen* is not obligatory, which include questions, embedding under certain modals, and in the predicative position of contrastive focus forms. He proposes that these syntactic structures license a covert counterpart of *pos*, and the restriction is syntactic. However, the data given in this section are not syntactically unique. A thorough study on these structures is beyond the scope of this article. I leave it for future research.

epistemic modal like (19), the bare form implies that the speaker is emphasizing a statement that is acknowledged in the context, while when *hen* is present, there is no such implication.

In conclusion, although *hen* can be absent, it implies that the statement is about a given standard, or a known fact. This feature cannot be explained directly by the *pos* analysis.

2.3. The puzzle of negation

A third puzzle regarding *hen* is related to negation. In Mandarin Chinese, there are two negation markers, *bu* and *mei*. *Bu* negates generic or habitual predicates, as in (20), and states, as shown in (21).

Generic and habitual readings:

(20) Wo bu chi mugua.
I NEG eat papaya
'I don't (generally) eat papayas.' (Ernst, 1995: 1)

States:

(21) Wo bu shi laoshi.
I NEG COP teacher
'I'm not a teacher.'

Mei negates eventive predicates and non-states (*a la* Lin, 2003; also see Huang, 1988; Ernst, 1995; Lee and Pan, 2001; Hsieh, 2001; a.m.o.). According to Lin, a predicate negated by *mei* has an episodic meaning. Therefore, compared to (21), (22) denies that there was an episode of papaya eating. Generally speaking, *mei* cannot negate states, as shown in (23) and (24).

(22) Wo mei chi mugua.
I NEG eat papaya
'I did not eat papayas.' (Ernst, 1995: 1)

(23) *Afu mei shi laoshi.
Afu NEG COP teacher
Intended: 'Afu is/was not a teacher.'

(24) *Afu mei gao.
Afu NEG tall
Intended: 'Afu is not tall.'

One would expect that a predicate with gradable adjectives to be negated by *bu* only, since it describes a state. An example is shown in (25).

***Hen* form under *bu*:**

(25) Afu bu hen gao.
Afu NEG HEN tall
'Afu is not tall.'

However, surprisingly, when *hen* is present, it can be negated by *mei*. This is shown in (26). When *hen* is absent, the sentence is ungrammatical, as shown in (24).

***Hen* form under *mei*:**
(26) Afu mei hen gao.
Afu NEG HEN tall
'Afu is/was not very tall.'

In comparison, the *shi…-de* form can only be negated by *bu*, never by *mei*, as shown in (27) and (28). In fact, the copula *shi* only co-exist with negation marker *bu*.

***Shi…-de* form:**
(27) Beizi bu shi man-de.
cup NEG COP full-DE
'The cup is not full.'

(28) *Beizi mei shi man-de
cup NEG COP full-DE

Table 1 is a summary of adjectival predicates in negation sentences. The major puzzle is that *hen* licenses the use of *mei*. It seems to imply that the *hen* form is more 'eventive' than the *shi…-de* form. This is the third phenomenon that the *pos* analysis cannot account for.

Table 1 Types of adjectival predicates under negation

	Mei	***Bu***
Hen	Ok	Ok
Shi…-de	No	No
Bare adjectives (no *hen*)	No	Ok

3. *Hen* sentences are subjective

3.1. Subjectivity in adjectives

In this section I propose that *hen* is related to a subjective reading. Subjectivity is related to people's opinions. It is well known that certain predicates are more subjective than others. One of the widely discussed topics on subjectivity in the domain of adjectives is on Predicates of Personal Tastes (PPTs) (See Kennedy, 2013; Lasersohn, 2005, 2009; Stephenson, 2007; Pearson, 2013; among others). Adjectives like *tasty* and *fun* have truth conditions relativized to a judge. In other words, a sentence like (29a) has the truth condition of (29b), in which *j* refers to the judge who makes the evaluation of what counts as tasty.

(29) a. The cake is tasty.
b. The cake is tasty for *j*.

In comparison, adjectives that have objective dimensions, such as *tall, large, heavy*, *dry*, *full*, *long*, *empty*, are generally not regarded as subjective.

There are two commonly discussed diagnostics to identify subjective predicates. The first one is called *faultless disagreement* (Kölbel, 2002; Lasersohn, 2005, 2009; among many others). Faultless disagreement refers to the phenomenon that participants of a conversation can argue over whether a statement is true, without reaching a real conclusion, since both of them are entitled to their own opinions. This is shown in (30). None of them can be wrong with respect to whether chili is tasty.

(30) *John*: The chili is tasty.
Mary: No! The chili is not tasty. (Lasersohn, 2005)

Lasersohn proposes that there should be an independent judge parameter, aside from the ordinary world and time parameters. He adopts a Kaplanian (Kaplan, 1989) approach in explaining faultless disagreement. Kaplan distinguishes between *characters* and *contents*. The character of a sentence is a function from context to the contents. When the indexicality of the character is resolved, the result is the content of the sentence. Faultless disagreement is the debate over the same content, but they are evaluated by different judge parameters. The case of PPTs contrasts with sentences with other indexical expressions, such as first person indexicals, as in (31). The expression *I'm a doctor* has different contents when uttered by different speakers. If what John says is true, Mary's objection here is infelicitous.

(31) *John*: I'm a doctor.
Mary: #No, you're not a doctor! (Lasersohn, 2005)

Another feature of subjective predicates is the capability of embedding under perceptual attitude verb, such as *find* (Sæbø, 2009; Kennedy, 2013). The English *find* is a verb that expresses a person's personal perceptions. Non-subjective adjectives, such as *tall*, are not acceptable under *find*, as shown in (32) and (33).

(32) John finds the cake tasty.

(33) #John finds Mary tall.

The *hen* form shows both characteristics. This is explained in the following sections.

3.2. Faultless disagreement in Mandarin Chinese

Similar to the PPTs, the *hen* form triggers faultless disagreement. This is shown in (36). Imaging the two speakers are arguing about whether Afu is a tall person. When using the *hen* form, it is more likely to trigger faultless disagreement than the *shi…-de* form, as in (35). By a native speaker's intuition, while the *hen* form provides a certain vagueness related to how the standard is set with respect to the speaker, the *shi…-de* form is related to a more absolute standard that is objective, without the need for assessment from the speaker.

(34) A: Afu hen gao
Afu HEN tall
'Afu is tall.'
B: Cuo! Afu bu gao!
wrong Afu NEG tall
'Wrong! Afu is not tall.'

(35) A: Afu shi gao-de
Afu COP tall-DE
'Afu is tall.'
B: Cuo! Afu bu-shi!
wrong Afu NEG-COP
'Wrong! Afu is not tall.'

This contrast is more obvious with absolute adjectives. When they appear with *hen,* there is vagueness with respect to what counts as significantly full for each individuals, which triggers faultless disagreement, as in (36). As for the *shi…-de* form, there is no faultless disagreement, as in (37).

(36) A: Beizi hen man.
cup HEN full
'The cup is very full.'
B: Cuo! Beizi bu hen man!
wrong cup NEG HEN full
'Wrong! The cup is not very full!'

(37) A: Beizi shi man-de
cup COP full-DE
'The cup is full.'
B: Cuo! Beizi bu shi man-de
wrong cup NEG COP full-DE
'Wrong! The cup is not full!'

In conclusion, there is a strong intuition that the *hen* form triggers faultless disagreement, and this contrast is particularly obvious when compared with the *shi…-de* counterpart.

3.3. Embedding under *ganjue* and *ganjue-dao* 'find/feel'

PPTs can embed under attitude verb *find*. Kennedy (2013) points out that only subjective predicates like PPTs can embed under *find* with positive forms, while non-subjective adjectives, such as *big*, *large* or *small,* cannot.

(38) a. Anna finds her bowl of pasta tasty/delicious. (Positive sentences)
b. ? Anna finds her bowl of pasta big/large/small.

Mandarin Chinese has two similar verbs, *ganjue* and *ganjue-dao* 'find/feel'. They have the same verb root *ganjue*, which literally means 'to feel.' They are both related to a person's gut feelings or judgment based on personal experiences. These two verbs are generally not completely acceptable to occur with non-subjective expressions, as shown in (39) and (40) respectively.

(39) ? Afu ganjue/ganjue-dao hua shi hong-se de
Afu find/feel flower COP red-color DE
Int. 'Afu finds the flower red.'

(40) ?? Afu ganjue/ganjue-dao konglong miejue-le
Afu find/feel dinosaurs extinct-PERF
Int. 'Afu find/feel that dinosaurs are extinct.'

A feature that *ganjue* and *ganjue-dao* have is that the judge often has low degree of certainty over his statements. Therefore, it is compatible with an expression in which the speaker second guesses himself.

(41) Wo ganjue/ganjue-dao Lisi hen bukekao, dan ye nanshuo.
I find/feel Lisi HEN unreliable but still hard-to-say
'I have the feeling that Lisi isn't reliable, but it's hard to say.'

Ganjue-dao is often related to evaluation over a specific situation, and it entails an event of direct encounter of the object. *Dao* is a morpheme can be literally translated as 'to' or 'reach' (Chen and Tao, 2014). When attached to a verb, *dao* adds the meaning that the agent expresses heightened senses and a high degree of transitivity (Chen and Tao, 2014), which is often related to direct perceptual encounters. According to Maienborn (2005), there are several often used diagnostics that can identify an event argument in the predicate position, such as the plausibility of locative and temporal modifiers, and the existence of manner adverbs. *Ganjue-dao* can appear with these three, as shown in (42) to (44) respectively.

Locative modifiers:

(42) Zai zheli Ali ganjue-dao ta hen congming.
at here Ali find/feel he HEN smart
'Here Ali had the feeling that he was smart.'

Temporal modifiers:

(43) Xianzai Afu ganjue-dao Ali hen mei.
Now Afu find/feel Ali HEN beautiful
'Now Afu feels that Ali is beautiful.'

Manner adverbs:

(44) Afu jianjian ganjue-dao Lisi hen congming.
Afu gradually feel/find Lisi HEN smart
'Afu gradually starts to feel that Lisi is smart.'

While *ganjue-dao* is related to direct perceptual experiences, *ganjue* allows guessing based on circumstantial or inferential evidence. Imagine a scenario where Afu has heard people's description of Lisi's build, and how he looks when he stands in a group, but Afu does not know Lisi's exact height, and he has never met him. It is felicitous to say (45) by using *ganjue*. On the contrary, *ganjue-dao* involves an event of actually observing or perceiving the object. Therefore, it is strange to use *ganjue-dao* in the same situation, as shown in (46).

(45)

Afu	ganjue	Lisi	hen	congming,	suiran	mei	gen	ta	peng-guo	mien.
Afu	find/feel	Lisi	HEN	smart	although	NEG	with	him	meet-EXP.PERF	face

'Afu has a feeling that Lisi is smart, although he never met him face to face.'

(46)

Afu	ganjue-dao	Lisi	hen	congming,	#suiran	mei	gen	ta	peng-guo	mien.
Afu	find/feel	Lisi	HEN	smart	although	NEG	with	he	meet-EXP.PERF	face

Int. 'Afu feels that Lisi is smart, although he never met him face to face.'

In conclusion, the *hen* sentences are licensed under both *ganjue* and *ganjue-dao*. The *hen* forms can be used to describe observations of direct perceptual encounters, as in the case of *ganjue-dao*, and also possible to have the reading based on inferential information, as shown in the sentences with *ganjue*.

4. The type of subjectivity of *hen*

What kind of subjectivity do *hen* sentences have? I propose that what *hen* contributes to the meaning is a standard that is evaluated by the judge according to his epistemic knowledge. In a sense, it is similar to subjective epistemic modals, which are statements based on speaker's subjective view. Viewing *hen* as parallel to epistemic modals has a second advantage. It explains why *hen* makes a weaker claim than the bare form: sentences with epistemic modals are usually weaker claims than simple statements (Karttunen, 1972; Lyons, 1977; Kratzer, 1991; Groenendijk and Stokhof, 1975; von Fintel and Gillies, 2009; among others). Therefore, a sentence like (47b) is intuitively weaker than (47a), as pointed out by Karttunen (1972).

(47) a. John left.
b. John must have left.

This type of subjectivity is distinct from what is widely discussed in the literature of PPTs. The subjectivity related to PPTs has two well-known features. First, the judge of PPTs should be the direct perceptual experiencer of the evaluated object. Second, a PPT sentence cannot really be denied. On the contrary, the judge of a *hen* sentence does not need to be the direct perceptual experiencer. A *hen* sentence can be denied, as long as there is further evidence to object to the judge's evaluation. These features make *hen* more similar to subjective epistemic modals than PPTs.

4.1. Comparison between *hen* and PPTs

According to Pearson (2013), PPTs requires the judge to be the direct experiencer of the described (stative) event of the object having the property attributed to it. This is shown in the infelicitous sentence (48).

(48) a. This cake is tasty to John. #But he hasn't tried it.
b. This cake is tasty to me. #But I haven't tried it.

However, *hen* does not have the same restriction. It is felicitous to say (49), where the judge does not have direct experiences towards Afu.

(49) Afu hen gao, dan wo mei yu-guo ta.
Afu HEN tall but I NEG met-EXP.PERF him
'Afu is tall, but I've never met him.'

For the speaker, to know whether Afu is tall does not require him to have perceptual experiences of Afu. This is not surprising, considering that *hen* can appear with a variety of gradable adjectives, not just those related to perceptual experiences.

4.2. Faultless disagreement of *hen* sentences

Hen sentences are not really subject to faultless disagreement. If enough information is provided with respect to how the standard is set, a *hen* statement can still be false. This is shown in the conversation in (50).

(50) A: Afu hen gao.
Afu HEN tall
'Afu is tall.'
B: Bu juede. Afu bu gao.
NEG find Afu NEG tall
'I don't think so. Afu isn't tall.'
A: Zai san-nianji xiaohai limian, Afu hen gao
in third-grade children among Afu HEN tall
'Among the third grade children, Afu is tall.'
B: Cuo-le! Wo jiao-guo de yi-nianji dou bi ta gao.
wrong-PERF I teach-EXP.PERF DE first-grade even COMP he tall
'Wrong! Even the first grades I taught was taller than him.'
A: Na wo xian wo cuo-le
then I think I wrong-PERF
'Then I guess I was wrong.'

In (50), Speaker A makes a statement that Afu is tall, based on his own understanding. Since it is unclear what his criteria are, there seems to be faultless disagreement. However, when Speaker A further clarifies that he bases his judgment on a group of third graders, the sentence can be denied by a more knowledgeable person like Speaker B. This is not the case in PPTs. It is infelicitous to negate speaker A's original statement.

(51) A: Zhe dangao hen haochi.
this cake HEN tasty
'This cake is tasty.'
B: Cuo-le. Youde geng haochi
wrong-PERF some better tasty
'Wrong! Some are tastier.'
A: #Haoba wo jian cuo le
Okay I say wrong PERF
'Okay. What I said was wrong.'

4.3. Similarity with subjective epistemic modality

Epistemic modals can be subcategorized into subjective and objective modals. According to Lyons (1977), subjective modals are related to personal and likely more incomplete evidence. This is illustrated by a sentence like (52).

(52) It may rain tomorrow.

When *may* is interpreted subjectively, it is reasoned according to someone's personal experiences. When it is interpreted objectively, it can be based on more solid evidence, such as scientific data (see Lyons, 1977; Drubig, 2001; von Fintel and Iatridou, 2002; von Fintel, 2003; Papafragou 2006; among others). Specifically, Papafragou (2006) views subjective modals as the special cases such that the modal claim is based on the speaker's personal belief alone, as opposed to beliefs shared by both the speaker and the hearer, or by a subset of people.

Although subjective modals are related to the speaker's knowledge or evidence, the statement expressed with a subjective modal can be challenged by other people when new evidence is available (Papafragou, 2006; von Fintel and Gillies, 2009; MacFarlane 2003). This is shown in an example originally from MacFarlane (2003), which is also discussed in Papafragou (2006).

(53) Sally: Joe might be in Boston.
George: He can't be in Boston. I just saw him in the hall five minutes ago.
(i) Sally: Oh, then I guess I was wrong.
(ii) Sally: Oh, OK. So he can't be in Boston. Nonetheless, when I said "Joe might be in Boston", what I said was true, and I stand by that claim.

The case of *hen* in (50) is similar. When speaker A first makes a *hen* statement, he is talking about evaluation based on his own knowledge. However, when new evidence is added by speaker B about the general height for first grade students, A's knowledge becomes irrelevant. Therefore, the *hen* sentence is parallel with epistemic modal *yiding* 'must', as in (54). Yet this distinction is not acceptable with PPTs, as in (51).

(54) A: Afu yiding zai jia.
Afu must at home
'Afu must be at home.'
B: Cuo-le, Afu lian-fenzhong qian hai zai bangongshi.
wrong-PERF Afu two-minute ago still at office
'Wrong! He was in the office two minutes ago.'
A: Haoba wo cai cuo le.
Ok I guess wrong PERF
'Ok, I guess I was wrong.'

5. *Hen* and parallelism with *seem* and *appear*

So far, I've shown that the *hen* form has several features that need to be accounted for. First, *hen* shows features of subjective predicates, such as triggering faultless disagreement, or at least superficially. Second, it licenses an adjectival predicate to appear with *mei*. Third, it is a standard given by a judge's knowledge state. Finally, in comparison with the bare form, the *hen* form makes a weaker assertion.

To account for these three features, I propose that *hen* is subjective in the sense that it introduces a standard based on a subjective knowledge state. *Hen* introduces an event of evaluation, in which the judge is the evaluator. As a result, it can be licensed under *mei. Hen* is similar to epistemic modality in making a weaker statement when compared with the bare form.

There is an interesting parallelism between *hen* and English verbs like *appear* and *seem*. According to Fernald (2000), these two verbs are related to speaker's judgment over a situation in an evaluative event, and make a generalization based on his evaluation. This is shown in (55). Adopting Carlsonian sorted types, here x is a stage of John, Q is some property of John, G is the generic quantifier, y is a stage realized by z, and z are individuals that are intelligent in general.

(55) a. John seems to be intelligent.
b. $\exists Q, x^s[\mathit{perceive}'(Q(x)) \,\&\, R(x, j) \,\&\, Q(x) \,\&\, Gy^s, z^i\, (Q(y) \,\&\, R(y, z))[\text{intelligent}'(z)]]$
(Modified from Fernald, 2000: 90)

The meaning of (55) is as follows. There exists some stage-level property Q, and a stage x^s, which refers to the sort of stage objects, such that John is realized as x, and there is a perceiving event of x, such that x has Q, and in general, for any stage y and any individual z such that z realizes as y, if y also has the property Q, then z is regarded as intelligent.

Hen can be analyzed in a similar manner. Here a judge is involved in an event of evaluation, and based on his knowledge, he could determine whether the object being evaluated possesses that property denoted by the gradable adjective.

(56) a. Afu hen gao
Afu HEN tall
'Afu is tall.

b. $\exists Q, x^s, v^i[R(x, Afu)\& \mathit{Eval}(Q(x))(v)\& Gy^s, z^i\ (Q(y)\& R(y, z))[tall'(z)]]$

In (56), there is a property Q, a stage x^s, and a judge v^i, such that the subject Afu is realized as x, and there is an evaluation event in which the judge v evaluates the stage x of Afu as having the property of Q, and for any stage y, individual z, if z is realized as y, and y has the property of Q, then z is tall.

6. Concluding remarks

On the surface, the Mandarin *hen* sentences are just the counterpart of English positive degree sentences. Yet different from English, they show properties of subjectivity. This work try to account for this property by seeing *hen* as introducing subjectivity in a similar manner as subjective modals. What *hen* does is introducing a subjective standard based on a judge's knowledge.

Although viewing *hen* as introducing a subjective standard is different is the traditional view that *hen* is *pos*, my analysis does not refute the idea that *hen* has the same function of *pos* in terms of binding the degree argument and avoiding type mismatches, as well as introducing a standard. The major difference of this analysis only lies in what the standard is based on. While the traditional *pos* analysis only requires a norm function that takes a comparison class and derives a norm from it, what *hen* does is to provide a norm based on a judge's knowledge state. Syntax-wise, *hen* is similar to a copula for avoiding type mismatches. Some languages are known to have different copulas that contrast in terms of subjectivity (de Bruyne, and Pountain, 1995; Maienborn, 2005; Geist, 2005), and the same contrast may also lie in positive degree morphemes.

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Coordination and focus particles (re?)united[1]

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Abstract. The aim of this paper is to sketch a unified semantics for coordination markers and focus particles. The main empirical motivation is found in the existence of some 'multipractic' particles in Serbian, *ni* and *i*, which serve as coordination markers, additive focus particles and scalar focus particles. A disjunction-based analysis can capture the polarity-sensitive behavior of *ni*, whereas *i* relies on a conjunction semantics. An approach that involves the exhaustification of alternatives is a crucial ingredient. Nonetheless, two types of exhaustification should be allowed — one corresponding to 'only' and the other one to 'even'.

Keywords: Negative Polarity Items, coordination, additive focus particles, scalar focus particles, exhaustification.

1. Introduction

Most research on coordination examines different aspects of conjunction and disjunction markers, focusing on the problems of their syntactic representation and the possibilities for interpretations based on the logical properties of corresponding connectives (Rooth and Partee (1982); Partee and Rooth (1983); Progovac (1998a, b); Szabolcsi and Haddican (2004); Zamparelli (2011)). Both conjunctions and disjunctions are scope-taking elements, and it is important to determine which constituents they have in their scope, as well as how they scopally interact with other functional expressions in a sentence. Special coordination markers that emerge in negative contexts, such as English 'neither… nor' (in (1), Wurmbrand (2008)) or French *(ni…) ni* (in (2), González and Demirdache (2015)), have sparked some interest (de Swart (2001); Doetjes (2005); Dagnac (2012); Paperno (2014)).

(1) Leo ate neither the rice nor the carrots.

(2) Zoé n'aime *(pas) le thé ni le café.
Zoé *NEG*.likes *NEG* the tea *ni* the coffee
'Zoé doesn't like tea nor coffee.'

At the center of attention of the research on this topic is what the logical nature of such connectives is, as well as their (scope) relations with negation. In a similar way, the issue of scope relations with negation and the source of polarity sensitivity are debated for different focus particles, as well:

(3) (Ian cooked the food.) He washed the dishes too/*either.

[1] I would like to thank the Harvard Linguistics Department, where I spent one semester as a visiting fellow, and especially professor Gennaro Chierchia. I am also thankful to Dorothy Ahn for her inspiring work. In addition, I benefited from a number of interesting suggestions from the anonymous reviewers of SuB21, as well as the participants of the conference. All errors are mine.

(4) (Ian didn't cook the food.) He didn't wash the dishes either/$^{?}$*too.

Among others, Rullmann (2003) and Ahn (2015) discuss the alternation between English 'too' and 'either'. An additive (existential) presupposition is identified as responsible for the contextual restrictions on the distribution of the focus particles in (3) and (4). In the case of scalar focus particles, such as English 'even' (in (5) and (6), Horn (1969)), there is an additional, scalar presupposition that the assertion is less likely than all of its alternatives (Karttunen and Peters (1979)).

(5) Even Muriel voted for Hubert.

(6) Not even Muriel voted for Hubert.

Are the three phenomena related in any way and do they have some features in common? What can be observed cross-linguistically is that, in certain cases, one item can perform all of these roles. Along with a 'plain' conjunction marker *i* (8), Serbian[2] disposes with a coordination marker that only surfaces in negative contexts — *ni* (7). Noting their apparent morphological kinship, a starting hypothesis could thus be that *ni* is the polarity sensitive counterpart of *i*.

(7) Sofija *(ne) piše (ni) pesme ni priče.
Sofija$_{\text{NOM}}$ NEG writes (ni) poems$_{\text{ACC}}$ ni stories$_{\text{ACC}}$
'Sofija doesn't write poems or stories'

(8) Sofija (ne) piše (i) pesme i priče.
Sofija$_{\text{NOM}}$ NEG writes (and) poems$_{\text{ACC}}$ and stories$_{\text{ACC}}$
'Sofija (doesn't) write(s) poems and/or stories'

As shown below, the same items can also serve as focus particles (FP), with both additive and scalar interpretations available, depending on the context.

(9) I Lea je uradila domaći.
FP Lea$_{\text{NOM}}$ $_{\text{AUX3Sg}}$ do$_{\text{PART}}$ homework$_{\text{ACC}}$
a. 'Lea did the homework, **too**'
b. '**Even** Lea did the homework'

(10) Ni Lea nije uradila domaći.
FP Lea$_{\text{NOM}}$ didn't do$_{\text{PART}}$ homework$_{\text{ACC}}$
a. 'Lea didn't do the homework, **either**'
b. 'Not **even** Lea did the homework'

This calls for an investigation of the possibility for a unified analysis of all these different uses of *ni* and *i*. The present paper outlines such a unified analysis, where *i* is treated as a conjunc-

[2] The language whose official name I use here, calling it Serbian, corresponds to what is (also) known as Bosnian-Croatian-Montenegrin-Serbian or Serbo-Croatian in the linguistic literature.

tion, but *ni* is a polarity sensitive disjunction, and it is only the nature of the individual members of coordination that differs in different uses — pronounced or silent. First the coordination role of *ni* and *i* will be examined, followed by a proposal of an analysis for *ni*. Next, the focus particle uses of *ni* and *i* will be presented, starting with the additive interpretation and followed by the scalar one, along with the corresponding accounts. Finally, some conclusions about a unified analysis will be laid out.

2. Coordination

The present section examines the particle *ni* as a coordination marker, comparing it to *i*.[3]

2.1. Distribution

In Serbian, sentential negation is indicated by the preverbal marker *ne* (turning into *ni-* when merging with certain auxiliaries). Being a strict Negative Concord language, the presence of multiple negatively marked expressions in one clause does not yield double negation readings in Serbian (11).

(11) Niko nikad ne jede ništa.
NEG-person NEG-time NEG eats NEG-thing
'Nobody ever eats anything'

The hallmark of the distribution of *ni*-coordination is the requirement for the presence of overt negation in the same clause. Different kinds of phrases can be coordinated by *ni*: DPs[4] (12), NPs (13), PPs (14), VPs (15). *Ni* can appear as a single marker, introducing only the last member of the coordination, but it can also be reiterated, thus one *ni* heading each member of the coordination. When coordinated constituents are preverbal, single *ni* is ungrammatical[5]. Even though single *ni* is acceptable post-verbally, reiterated *ni* is generally preferred in all positions.

(12) a. *(Ni) Sofija ni Lea ne ide/idu u školu.
ni Sofija$_{NOM}$ ni Lea$_{NOM}$ NEG go$_{Sg}$/go$_{Pl}$ to school$_{ACC}$
'Neither Sofija nor Lea go to school'

b. Sofija nije upoznala ?(ni) mog brata ni tvoju sestru.
Sofija$_{NOM}$ didn't meet$_{PART}$ ni my$_{ACC}$ brother$_{ACC}$ ni your$_{ACC}$ sister$_{ACC}$
'Sofija didn't meet my brother or your sister'

(13) a. *(Ni) devojčice ni dečaci ne vole spanać.
ni girls$_{NOM}$ ni boys$_{NOM}$ NEG like$_{Pl}$ spinach$_{ACC}$
'Neither girls nor boys like spinach'

[3] A detailed discussion of the conjunction marker *i* is outside of the scope of the present paper; the reader is referred to Arsenijević (2011).
[4] Both singular and plural agreement on the verb are possible.
[5] Nonetheless, even postverbal subjects coordinated by single *ni* yield strongly degraded sentences.

b. Sofija ne voli ni španać ni šargarepu.
Sofija$_{\text{NOM}}$ $_{\text{NEG}}$ likes ni spinach$_{\text{ACC}}$ ni carrots$_{\text{ACC}}$
'Sofija doesn't like spinach or carrots'

(14) Sofija ne čuva knjige ?(ni) na polici ni u fijoci.
Sofija$_{\text{NOM}}$ $_{\text{NEG}}$ keep$_{\text{3Sg}}$ books$_{\text{ACC}}$ ni on shelf$_{\text{LOC}}$ ni in drawer$_{\text{LOC}}$
'Sofija doesn't keep books on the shelf or in the drawer'

(15) a. Lea nije (ni) pojela sendvič ni popila jogurt.
Lea$_{\text{NOM}}$ didn't ni eat$_{\text{PART}}$ sandwich$_{\text{ACC}}$ ni drink$_{\text{PART}}$ yogurt$_{\text{ACC}}$
'Lea didn't eat a/the sandwich or drink (the) yogurt'
b. Sofija neće (ni) sašiti ni kupiti haljinu.
Sofija$_{\text{NOM}}$ won't ni sew$_{\text{INF}}$ ni buy$_{\text{INF}}$ dress$_{\text{ACC}}$
'Sofija will neither sew nor buy a/the dress'

The conjunction marker *i* can coordinate all of the above phrases, but also CPs (20, 21).

(16) a. (I) Sofija i Lea (ne) ide/idu u školu.
and Sofija$_{\text{NOM}}$ and Lea$_{\text{NOM}}$ $_{\text{NEG}}$ go$_{\text{Sg}}$/go$_{\text{Pl}}$ to school$_{\text{ACC}}$
'(Both) Sofija and Lea (don't) go to school'
b. Sofija (ni)je upoznala (i) mog brata i tvoju sestru.
Sofija$_{\text{NOM}}$ didn't meet$_{\text{PART}}$ and my$_{\text{ACC}}$ brother$_{\text{ACC}}$ and your$_{\text{ACC}}$ sister$_{\text{ACC}}$
'Sofija (didn't) m(e)et (both) my brother and your sister'

(17) a. (I) devojčice i dečaci (ne) vole španać.
and girls$_{\text{NOM}}$ and boys$_{\text{NOM}}$ $_{\text{NEG}}$ like$_{\text{Pl}}$ spinach$_{\text{ACC}}$
'(Both) girls and boys (don't) like spinach'
b. Sofija (ne) voli (i) španać i šargarepu.
Sofija$_{\text{NOM}}$ $_{\text{NEG}}$ likes and spinach$_{\text{ACC}}$ and carrot$_{\text{ACC}}$
'Sofija (doesn't) like (both) spinach and carrots'

(18) Sofija (ne) čuva knjige (i) na polici i u fijoci.
Sofija$_{\text{NOM}}$ $_{\text{NEG}}$ keep$_{\text{3Sg}}$ books$_{\text{ACC}}$ and on shelf$_{\text{LOC}}$ and in drawer$_{\text{LOC}}$
'Sofija (doesn't) keep(s) books (both) on the shelf and in the drawer'

(19) a. Lea (ni)je (i) pojela sendvič i popila jogurt.
Lea$_{\text{NOM}}$ didn't and eat$_{\text{PART}}$ sandwich$_{\text{ACC}}$ and drink$_{\text{PART}}$ yogurt$_{\text{ACC}}$
'Lea (didn't) (both) eat/ate a/the sandwich and drink (the) yogurt'
b. Sofija (ne)će (i) sašiti i kupiti haljinu.
Sofija$_{\text{NOM}}$ won't and sew$_{\text{INF}}$ and buy$_{\text{INF}}$ dress$_{\text{ACC}}$
'Sofija will (both/neither) sew and/or buy a/the dress'

(20) (I) Sofija je pojela sendvič i Lea je popila jogurt.
and Sofija$_{NOM}$ $_{AUX3Sg}$ eat$_{PART}$ sandwich$_{ACC}$ and Lea$_{NOM}$ $_{AUX3Sg}$ drink$_{PART}$ yogurt$_{ACC}$
'Sofija ate a/the sandwich and Lea drank (the) yogurt'

(21) Ko je došao i šta si video?
who$_{NOM}$ $_{AUX3Sg}$ come$_{PART}$ and what$_{ACC}$ $_{AUX2Sg}$ see$_{PART}$
'Who came and what did you see?'

Unlike *ni*, *i* doesn't have a restricted distribution — it is grammatical in both positive and negative environments, as shown in the examples above. Like *ni*, *i* can also appear as a single or reiterated marker. Nonetheless, single *i* is fully grammatical in all positions, especially when no contrastive focalisation is involved.

Do the apparent morphological kinship between the two coordination markers and their similar distribution indicate that *ni* is to be analyzed as a conjunction? Arsenijević (2011) offers an analysis of Serbo-Croatian connectives (*i, a, ali, ili, ni*), focusing on their morphological make-up and the syntax and semantics that can be derived from it, as well as their information structural behavior. In his account, *ni* is described as a negative conjunction, but without weighing in on the possible consequences of such an analysis.

2.2. Conjunction or disjunction?

Out of these two coordination markers, *ni* is the one whose status is debatable. For a strict NC language, such as Serbian, two questions emerge:

- Is *ni* inherently negative or semantically non-negative?
- Is it a conjunction or a disjunction?

It has been proposed that *ni* is a negative conjunction (Arsenijević (2011)). Yet, this is only one of the four logical possibilities resulting from the combination of the two relevant questions:

1. If *ni* is an inherently negative disjunction, the presence of a negative operator in each disjunct would predict readings that are not attested for Serbian sentences with *ni* (such as: 'Lea didn't eat a sandwich or she didn't drink yogurt' for the example in (15a)).

2. If *ni* is a semantically non-negative conjunction, its dependence on the presence of a clausemate negative operator is problematic.

3. If *ni* is an inherently negative conjunction, each conjunct needs to introduce a negative operator of its own.

4. If *ni* is a non-negative disjunction, all disjuncts would have to be in the scope of one negative operator.

Maintaining only options (3.) and (4.), we establish that they are, in fact, predicted to yield logically equivalent interpretations, as stated by one of the de Morgan's equivalences (22):

(22) $[\neg p] \wedge [\neg q] = \neg[p \vee q]$

This makes it impossible to tease apart an interpretation of the *ni*-coordination as a conjunction that has negative operators in its scope (23a) from the one where it is a disjunction in the scope of a negative operator (23b), in simple sentences like (23). At the same time, a reading available for negated 'plain' conjunction *i* (in (24)), but not for *ni* (in (23)), is the one where the conjunction is in the scope of sentential negation, as paraphrased in (24b),[6] cf. Arsenijević (2011).

(23) Sofija ne piše (ni) pesme ni priče.
Sofija$_{\text{NOM}}$ NEG writes (ni) poems$_{\text{ACC}}$ ni stories$_{\text{ACC}}$
a. 'Sofija doesn't write poems and she doesn't write stories' $[\neg p] \wedge [\neg q]$
b. 'Sofija doesn't write poems or stories' $\neg[p \vee q]$

(24) Sofija ne piše (i) pesme i priče.
Sofija$_{\text{NOM}}$ NEG writes (and) poems$_{\text{ACC}}$ and stories$_{\text{ACC}}$
a. 'Sofija doesn't write poems and she doesn't write stories' $[\neg p] \wedge [\neg q]$
b. 'Sofija doesn't write (both) poems and stories (only one of the two)' $\neg[p \wedge q]$

Thus, not only have *ni* and *i* a similar morphological make-up, they also have one interpretation in common, in negative sentences. In the case of *i*, there is no reason to doubt the conjunction status of the connective, as it displays both scope orderings with respect to sentential negation. But is there a way to disentangle the two interpretations of *ni* ((23a) vs. (23b)) and determine whether it is a conjunction or a disjunction?

2.3. Determining the scope of *ni*

In order to create a more transparent LF, an additional scope-taking element can be inserted in the structure. One possible way is to pick a necessity modal as a 'scope-intervener'. This diagnostic would be parallel to the so-called split-scope readings in Germanic languages (Penka (2010); Zeijlstra (2011)). A necessity modal that is interpreted in the scope of sentential negation allows to test whether *ni* is unambiguously a narrow scope disjunction (25). However, if the modal is outscoped by both the sentential negation and the *ni*-coordination, two equivalent interpretations (26) are again possible.

(25) $\neg > \Box > [p \vee q]$

(26) a. $\neg\, [[\Box p] \vee [\Box q]]$ = b. $[\neg\Box p] \wedge [\neg\Box q]$

The corresponding readings available for the Serbian example in (27) are paraphrased below:

[6]When *i* is reiterated in the negated sentence in (24), only the reading (24b) is available.

(27) (Sofija) ne mora ni da kuva ni da čisti.
Sofija$_{\text{NOM}}$ $_{\text{NEG}}$ has-to ni $_{\text{FIN}}$ cook ni $_{\text{FIN}}$ clean
   a. (25): 'it is not necessary that Sofija cooks or cleans'
   b. i. (26a): 'it is not the case that it is necessary for Sofija to cook or that it is necessary for Sofija to clean'
      ii. (26b): 'it is not necessary for Sofija to cook and it is not necessary for Sofija to clean'

These readings don't appear to be very distinct from each other, and this is because there is an entailment relation between them: the scopal configuration in (25) entails the ones in (26). It thus needs to be verified whether the only possible reading is the one paraphrased in (27a) or whether the readings in (27b) are independently available. A potential disambiguating scenario would be the following one:

(28) Sofija's aunt owns a restaurant and she needs some extra workforce, namely for cooking and cleaning, so Sofija's mother sends her over to help out during summer holidays. The mother thus obliged Sofija to help her aunt out in the restaurant, but without designating either of the two chores as a particular requirement.

The scenario in (28) renders only (26/27b) true. Importantly, the sentence in (27) is not accepted by native speakers in this scenario, which discards the reading in (27b). This provides evidence for a narrow-scope disjunction account of *ni*, since the only available reading is the one (27a) where *ni* cannot be reanalyzed as a wide scope conjunction.

Intervention with modals speaks in favor of analyzing *ni* as a disjunction in the scope of sentential negation. But is there any further evidence? A second test for teasing apart the two interpretations involves a quantificational adverb as the intervening element, inspired by Shimoyama (2011). An adverb that outscopes sentential negation allows to test whether *ni* is unambiguously a wide scope conjunction (29). Nonetheless, when the adverb outscopes both the sentential negation and the *ni*-coordination, two equivalent interpretations are possible (30).

(29) $(Q_{adv}\ \neg p) \wedge (Q_{adv}\ \neg q)$

(30) a. $Q_{adv} > (\neg p \wedge \neg q)$ = b. $Q_{adv} > \neg(p \vee q)$

If *ni* is a conjunction that has the negative operators in its scope, the interpretation in (29) should be available for the sentence in (31). But the reading in (31b), which can be represented through two logically equivalent LFs, also seems to be available, at first glance.

(31) Sofija obično nije (ni) kuvala ni čistila.
Sofija$_{\text{NOM}}$ usually didn't ni cook$_{\text{PART}}$ ni clean$_{\text{PART}}$
   a. (29): 'It was usually not the case that Sofija cooked and it was usually not the case that Sofija cleaned'
   b. i. (30a): 'It was usually the case that Sofija didn't cook and that Sofija didn't clean'

ii. (30b): ‘It was usually not the case that Sofija cooked or cleaned’

Again, there is an entailment relation between these readings: the one in (31b) entails the one in (31a). In order to check whether the configuration in which *ni* can only be interpreted as a conjunction scoping over negation (31a) is available independently form the other one (31b), a context incompatible with the latter needs to be construed. Such a disambiguating scenario is given in the table in (32) — this state of affairs is compatible only with the interpretation in (31a). The reading in (31b) does not correspond to the distribution given in (32) because there were only two out of six days in which Sofija neither cooked nor cleaned (namely Tuesday and Friday), and this is not the majority of days, thus insufficient for employing ‘usually’. When native speakers are asked to judge, the sentence in (31) turns out to be unacceptable in the distribution depicted in (32). This provides evidence against an analysis of *ni* as a conjunction that outscopes sentential negation.

(32)

	Mon	Tue	Wed	Thu	Fri	Sat
cooking	yes	no	no	no	no	yes
cleaning	no	no	yes	yes	no	no

Tests that rely on more complex quantificational configurations, with necessity modals or quantificational adverbs as potential interveners, show that Serbian *ni* behaves as a disjunction in the scope of a negative operator and not as a conjunction that scopes over negative operators.

An additional argument against a conjunction-based analysis comes from the observation that *(ni. . .) ni* is incompatible with collective predicates, as shown in the examples (33, 34). Furthermore, a predicate of a sentence whose subjects are coordinated by *ni* cannot be overtly modified with ‘together’ (35).

(33) * Ni Sofija ni Lea (ni Marko) se nisu sreli u biblioteci.
ni Sofija$_{\text{NOM}}$ ni Lea$_{\text{NOM}}$ ni Marko$_{\text{NOM}}$ $_{\text{REFL}}$ didn’t meet$_{\text{PART}}$ in library$_{\text{LOC}}$
‘Sofija, Lea and Marko didn’t meet (each other) in the library.’

(34) * Ni Sofija ni Lea (ni Marko) nisu oformili tim.
ni Sofija$_{\text{NOM}}$ ni Lea$_{\text{NOM}}$ ni Marko$_{\text{NOM}}$ didn’t form$_{\text{PART}}$ team$_{\text{ACC}}$
‘Sofija, Lea and Marko didn’t form a team (together).’

(35) * Ni Sofija ni Lea (ni Marko) ne pišu projekte zajedno.
ni Sofija$_{\text{NOM}}$ ni Lea$_{\text{NOM}}$ ni Marko$_{\text{NOM}}$ $_{\text{NEG}}$ write$_{\text{PI}}$ projects$_{\text{ACC}}$ together
‘Sofija, Lea and Marko don’t write projects together’

This would be unexpected for a conjunction-based connective, as they normally exhibit non-Boolean interpretations with coordinated subject NPs/DPs (Champollion (2016)). However, Sofija and Lea (and Marko) cannot be interpreted as a semantic plurality in the examples above.

2.4. Strong NPI *ni*

The previous section revealed empirical evidence for a narrow scope disjunction analysis of Serbian *ni*, where it has been shown that this coordination marker must remain in the scope of sentential negation. This finding makes *ni* a good candidate for an NPI[7] (Ladusaw (1979), Chierchia (2013), inter alia), as exemplified for English 'anyone' in (36). But NPIs are known to be grammatical in weaker, Downward Entailing (DE) environments,[8] such as the scope of 'few' in (37).

(36) Lea didn't see anyone.

(37) Few students saw anyone.

Ni-coordination is ungrammatical in DE contexts, as shown in (38). But this only means that *ni* cannot be analyzed as a weak NPI (Zwarts (1998)).

(38) *Malo dece voli (ni) španać ni šargarepu.
few children GEN likes ni spinach ACC ni carrot ACC
'Few children like spinach or carrots'

In fact, *ni*-coordination is grammatical only in anti-additive (39) contexts.[9] This makes it a suitable candidate for a strong NPI.

(39) Niko ne voli (ni) španać ni šargarepu.
ni-who NOM NEG likes ni spinach ACC ni carrot ACC
'Nobody likes spinach or carrots'

What is the syntactic and semantic mechanism that is behind such polarity sensitivity of *ni*?

3. Proposal

Building on the work of his predecessors (Kadmon and Landman (1993), Krifka (1995), Gajewski (2002)), Chierchia (2013) argues that the source of polarity sensitivity of NPIs is a logical contradiction that arises when they appear in an upward or non-monotone environment. What distinguishes NPIs from expressions that are not polarity sensitive are the obligatory alterna-

[7]The unclear status of the *ni*-coordination in fragment answers makes an analysis in terms of a pure neg-word (Negative Concord Item) less appealing.

(i) A: Koga si pozvao? B: ??? Ni Leu ni Sofiju.
who ACC AUX2Sg invite PART *ni* Lea ACC *ni* Sofija ACC
A: Who did you invite? B: ??? Neither Lea nor Sofija.

[8]These environments allow for inferences from sets to subsets: 'Few girls wore dresses' → 'Few girls wore blue dresses'.

[9]Such environments satisfy the equivalence: f(X∪Y) ⇔ f(X)∩f(Y); for example — 'No girls sang or danced' is equivalent to 'No girls sang and no girls danced'.

tives that NPIs introduce, as well as the presence of a covert exhaustifying operator. The null head that hosts this operator must be able to value the features present on the NPI, through a feature-checking operation under c-command. The role of the operator is then to negate all the alternatives activated by the NPI that are not entailed by the assertion. In a non-DE context such exhaustification will lead to a contradiction.

Understood through this framework, the polarity sensitive behavior of Serbian *ni* stems from the presence of two formal features [σ,D] which need to be valued by matching features present on a c-commanding operator $O^{S}_{[+\sigma,+D]}$. Once the agreement between $ni_{[-\sigma,-D]}$ and $O^{S}_{[+\sigma,+D]}$ is established, the scalar (σ) and subdomain (D) alternatives are activated for the *ni*-coordination. The scalar (σ) alternative for a disjunction is a conjunction (its stronger scalemate), whereas subdomain (D) alternatives are drawn from the individual members of the *ni*-coordination. The role of the O^S operator is to perform the exhaustification of both scalar and domain alternatives associated with the *ni*-coordination.[10] In other words, all alternatives that are not entailed by the assertion have to be negated. The O^S operator (40)[11] is thus similar in effect to the focus particle 'only'.

(40) $\| O_{(\sigma,D)\text{-ALT}}\ \phi \|^{g,w} = \| \phi \|^{g,w} \wedge \forall p \in \| \phi \|^{(\sigma,D)-ALT} [p \rightarrow \lambda w' \| \phi \|^{g,w'} \subseteq p]$

When *(ni...) ni* is found in a positive sentence (41), the exhaustified alternatives end up being incompatible with the assertion (42a). Namely, the result of the exhaustification performed by O^S (42e) states that neither of the individual disjuncts (*p,q*) is true, but the assertion says that (at least) one of them must be true (due to the meaning of the disjunction). This yields a clear contradiction, as shown in (42e).

(41) *Sofija piše (ni) pesme ni priče.
Sofija$_{\text{NOM}}$ writes (ni) poems$_{\text{ACC}}$ ni stories$_{\text{ACC}}$
'Sofija writes *ni* poems *ni* stories'

(42) a. Assertion: $O^S(p \vee q)$
b. where *p* = 'Sofija writes poems' and *q* = 'Sofija writes stories'
c. Scalar (σ) alternatives: $p \wedge q$
d. Subdomain (D) alternatives: p, q
e. After EXH: $(p \vee q) \wedge \neg(p \wedge q) \wedge \neg p \wedge \neg q$

Sets of scalar and subdomain alternatives are posited for the 'plain' disjunction (such as English 'or'), as well (Sauerland (2004); Fox (2007)). What makes the difference in the case of NPIs, such as *ni*, is that these alternatives are always present and must invoke the presence of an exhaustifying operator. This is due to the agreement operation between the covert ONLY-operator and *ni*, which is required for the syntactic grammaticality of the sentence. But this restricts a *ni*-coordination to anti-additive contexts, such as the sentential negation in (43), since it is logically sustainable only in such scale-reversing environments. Plain disjunction

[10] Arsenijević (2011) also mentions a 'Domain-Broadening effect', referring to Chierchia (2006), introduced by the combination of the negative marker component *n-* and the additive *i* in *ni*.

[11] Modified from Chierchia (2013), p.138.

'or', for example, does not have such a restricted distribution, since its sets of alternatives are not necessarily active.

(43) Sofija ne piše (ni) pesme ni priče.
Sofija$_{NOM}$ $_{NEG}$ writes (ni) poems$_{ACC}$ ni stories$_{ACC}$
'Sofija doesn't write poems or stories'

(44) a. Assertion: $O^S\neg(p\vee q)$
b. where p = 'Sofija writes poems' and q = 'Sofija writes stories'
c. Scalar (σ) alternatives: $\neg(p\wedge q)$
d. Subdomain (D) alternatives: $\neg p$, $\neg q$
e. After EXH: $\neg(p\vee q)$

In contrast, when a negative environment hosts *ni*-coordination (43), the exhaustification of alternatives turns out to be vacuous (44e). This time, the assertion (44a) is the strongest of all the alternatives, i.e. it entails all the other alternatives — scalar (44c), as well as subdomain (44d), so there is no alternative to be negated. Crucially, after the syntactic agreement is effectuated and the sets of alternatives activated, no logical contradiction arises.

3.1. Why 'strong'?

If a scale-reversing context prevents the logical contradiction to arise due to the presence of an NPI, it is still unclear why *ni*-coordination needs an anti-additive environment and why it is not acceptable in a weaker DE context. Following Gajewski (2011), Chierchia (2013) argues that it is not the anti-additivity to be held responsible for this. He introduces a parametric switch manifested in the so-called strong exhaustification, performed by O^S. Instead of exhaustifying only subdomain alternatives,[12] O^S is sensitive to the scalar alternatives as well. But, once it is invoked, the O^S operator cannot remain blind to the potential alternatives of other scalar elements that can be found in the same sentence. As a result, when found in the scope of an alternative-sensitive operator at LF, even scalar items which do not obligatorily carry active sets of alternatives, such as the quantifier 'few NP', have their scalar alternatives activated, for example, 'some NP'. For this reason, *(ni…) ni* is ungrammatical in DE contexts such as the scope of 'few NP' in (45) — 'few children like x' gives rise to an additional implicature that 'some children like x' and this positive implicature provokes a contradiction, as shown in (46e).[13]

(45) * Malo dece voli (ni) španać ni šargarepu.
few children$_{GEN}$ likes ni spinach$_{ACC}$ ni carrot$_{ACC}$
'Few children like spinach or carrots'

[12] This would, in fact, be sufficient to account for weak NPIs, since negating their scalar alternative in a positive context wouldn't lead to a contradiction — 'It is not the case that Sofija writes poems and stories' is not incompatible with 'Sofija writes poems or stories', it is merely an implicature that would arise obligatorily.

[13] Along with its scalar alternatives, subdomain alternatives are also triggered for FEW, however, this is not exemplified here, as scalar alternatives suffice to make the point.

(46) a. Assertion: O^S FEW*ch* (P OR Q)
b. where P = 'like spinach', Q = 'like carrots', and FEW*ch* = 'few children'
c. Scalar (σ) alternatives: FEW*ch* (P AND Q); NO*ch* (P OR Q), NOT-ALL*ch*(P OR Q),...
d. Subdomain (D) alternatives: FEW*ch* P, FEW*ch* Q
e. After EXH: FEW*ch* (P OR Q) $\wedge$ FEW*ch* (P AND Q) $\wedge$ $\neg$**NO*ch* (P OR Q)** $\wedge$ NOT-ALL*ch*(P OR Q) = FEW*ch* (P OR Q) $\wedge$ FEW*ch* (P AND Q) $\wedge$ **SOME*ch* (P OR Q)** $\wedge$ NOT-ALL*ch* (P OR Q)

Strong exhaustification thus takes into account not only the truth-conditional component of the meaning, but also the presuppositions and the implicatures. This is why strong NPIs are not acceptable in DE contexts, since additional scalar implicatures may arise and yield a contradiction after exhaustification. In contrast, weak NPIs are not coupled with an operator that performs strong exhaustification O^S, but with a 'plain' operator O, which looks only at the truth-conditional component of meaning and neglects presuppositions and implicatures.

3.2. What about *i*?

The conjunction *i* does not carry obligatory sets of scalar and subdomain alternatives (for whose activation the formal features [σ] and [D] are in charge). Therefore, as a coordination marker, *i* does not depend on the presence of an exhaustification operator, nor a scale-reversing environment for that matter. Activation of these alternatives is, nonetheless, possible, the difference with respect to *ni* being that it is not obligatory for *i*.

4. Focus particles

As exemplified in the introduction of this paper, both *i* and *ni* can serve as focus particles. Depending on whether the set of focal alternatives entailed by the previous context is ordered on a likelihood scale or a simple unordered set, the contribution to the interpretation is, respectively, that of a scalar or an additive focus particle. The present section argues that an 'even'-based exhaustification is thus needed for both particles in their scalar focus particle incarnation.

4.1. Additive focus particles *i* and *ni*

As an additive focus particle, *i* can associate with constituents of different kinds and activate the corresponding unordered sets of focus alternatives ((47a) for the example in (47b)).[14] Following Ahn (2015)'s analysis of English 'too', *i* is analyzed as a conjunction which, this time, takes as its arguments the host proposition p and a silent anaphor q (48), where q is a member of the focus value (Rooth (1992)) of p. This means that, when the conjunction *i* lacks overt multiple conjuncts, one of its members of coordination remains covert, and this is the null anaphor. Due to the presence of the anaphor, a salient antecedent must be available in the preceding context

[14] Serbian is a pro-drop language.

in order for the sentence with an additive *i* to be felicitous. The anaphor *q* thus must be entailed by a member of the set of alternatives in the focus value of *p* (Rullmann (2003)), and this alternative must be distinct from *p* (Kripke (2009)). No exhaustification takes place, since *i* does not carry any formal features in charge of activating scalar and subdomain alternatives.

(47) a. 'She washed the dishes', 'She fed the dog', 'She practised the piano'...
b. I domaći je uradila.
also homework$_{ACC}$ $_{AUX3Sg}$ do$_{PART.F}$
'She also did the homework'

(48) Assertion: p∧q

Ni also serves as an additive focus particle, but one that only appears in anti-additive contexts, similar to English 'either'. In this use, single *ni* attaches to a focalized constituent and activates the corresponding unordered set of alternatives ((49a) for (49b)). Additive focus particle *ni* is infelicitous in the absence of a negative contextual antecedent.

(49) a. 'She didn't wash the dishes', 'She didn't feed the dog', 'She didn't practise the piano'...
b. Ni domaći nije uradila.
(n)either homework$_{ACC}$ didn't do$_{PART.F}$
'She didn't do the homework, either'

This is due to the presence of a silent anaphor in the semantics of focus particle *ni*, which must be entailed by a member of the set of focus alternatives of the host proposition. *Ni* is analyzed as a disjunction which takes as its arguments the host proposition *p* and the silent anaphor *q* (following Ahn (2015)'s proposal for 'either' in English). The difference between *ni*-coordination and *ni* additive particle is that in the latter case one disjunct is covert.

The polarity sensitivity of the additive focus particle *ni* is predicted by its disjunctive nature. Even in the absence of overt multiple members of the coordination, *ni* carries the formal features [σ,D] in charge of activating scalar and subdomain alternatives. The same exhaustification mechanism is at work and it applies vacuously in a negative environment (50), such as in the example in (49b). This is due to the fact that the assertion (50a) is the strongest alternative (50e).

(50) a. Assertion: $O^S\neg(p\vee q)$
b. where p = 'She did the homework' and $q\in[[p]]^F$
c. Scalar (σ) alternatives: $\neg(p\wedge q)$
d. Subdomain (D) alternatives: $\neg p$, $\neg q$
e. After EXH: $\neg(p\vee q)$

Additive focus particle *ni* is unacceptable in a positive sentence (51) for the same reason as the coordination marker *ni* — a contradiction arises between the assertion and the exhaustified alternatives (52e).

(51) * Ni domaći je uradila.
(n)either homework$_{ACC}$ $_{AUX3Sg}$ do$_{PART.F}$
'*She did the homework, either'

(52) a. Assertion: $O^S(p \vee q)$
b. where p = 'She did the homework' and $q \in [[p]]^F$
c. Scalar (σ) alternatives: $p \wedge q$
d. Subdomain (D) alternatives: p, q
e. After EXH: $(p \vee q) \wedge \neg(p \wedge q) \wedge \neg p \wedge \neg q$

It turns out that the coordination and the additive focus particle use of *(n)i* can be treated on a par, if the status of the arguments that they take as a conjunction or a disjunction is allowed to be different — either an overt member of the coordination or a silent anaphor.

4.2. Scalar focus particles *i* and *ni*

When used as focus particles, *ni* and *i* can have either an additive or a scalar contribution to the meaning of the sentence. The flip from the former to the latter is made once the set of focus alternatives becomes ordered on a likelihood scale, as exemplified for *i* in (53) and for *ni* in (54).

(53) a. 'She did the homework' <'She washed the dishes' <'She fed the dog'...
b. (Čak) i domaći je uradila.
even even homework$_{ACC}$ $_{AUX3Sg}$ do$_{PART.F}$
'She even did the homework'

(54) a. 'She didn't do the homework' <'She didn't wash the dishes' <'She didn't feed the dog'...
b. (Čak) ni domaći nije uradila.
even even homework$_{ACC}$ didn't do$_{PART.F}$
'She didn't even do the homework'

The importance of the context is essential — the distinction between an additive and a scalar use of these particles depends solely on whether the alternatives are ordered or not, and this information can be retrieved from the context. The interpretation of *ni* and *i* as scalar focus particles requires emphasis and heavy stress is needed on the associate of the particle. Some other circumstances that can enforce this are information structural effects and the addition of an 'even'-like particle in Serbian — *čak*.[15] As for the latter, the presence of *čak* is possible, but

[15] In the case of the scalar focus particle *i*, the universal quantifier *sve* (= 'everything') can marginally be used instead of *čak*.

not necessary. As a rough generalization, this additional particle is needed when the constituent that *(n)i* is attached to is topicalized.[16]

Is there an account for the scalar uses of *i* and *ni* that would be parallel to the one proposed in the previous section for the additive uses? Recall that we made use of conjunctions and disjunctions of the assertions and some propositional anaphors, respectively. ONLY-exhaustification was then used to explain the restricted distribution of *ni*. The difference that exists between the additive and the scalar use of these focus particles requires a different operator, one that can capture the scalar ordering of alternatives. An operator modelled after 'even' has been proposed by Chierchia (2013):

(55) $E_{ALT}(p) = p \wedge \forall q \in ALT\ [p <_{\mu} q]$
where '$p <_{\mu} q$' says that p is less likely than q with respect to some contextually relevant probability measure μ

When applied to the examples above ((53) and (54)), such EVEN-exhaustification looks like (56) and (57), respectively.

(56) Scalar focus particle *i*
a. Assertion: $E(p \wedge q)$
b. where p = 'She did the homework' and $q \in [[p]]^F$
c. After EXH: $p \wedge q \wedge p <_{\mu} q$

(57) Scalar focus particle *ni*
a. Assertion: $\neg E^S(p \vee q)$
b. where p = 'She did the homework' and $q \in [[p]]^F$
c. Scalar (σ) alternatives: $\neg(p \wedge q)$
d. Subdomain (D) alternatives: $\neg p$, $\neg q$
e. After EXH: $\neg(p \vee q \vee p <_{\mu} q) = \neg p \wedge \neg q \wedge \neg p <_{\mu} \neg q$

The E operator is invoked to signal that the assertion is the least likely among the relevant alternatives. Such a mechanism is needed both for the scalar focus particle *i* (56) and for the scalar focus particle *ni* (57). This is the first time that some sort of exhaustification is needed for both the polarity sensitive (*ni*) and the 'plain' item (*i*). Note that, distributionally, these two expressions obey the same restrictions when they are scalar focus particles, as when they are additive focus particles — that is, *ni* is only grammatical in anti-additive contexts.

As a disjunction bearing [-σ,-D] features, *ni* gets checked and valued by a c-commanding $E_{[+\sigma,+D]}$ operator. E^S activates a set of parallel, focus alternatives, ordered with respect to some contextually salient probability measure μ. In the case of the scalar use of *i*, the result of the exhaustification (56c) assures not just that both the assertion and the propositional anaphor hold (as with the additive use), but also that the former is less likely than the latter. As for the

[16] It feels more natural to have the word order used in the examples (53b) and (54b) when scalarity is invoked without the help of the 'even'-like particle *čak*, although other word orders are also seem to be possible.

scalar use of *ni*, after exhaustification we get that not only the assertion and the propositional anaphor do not hold, but also the assertion not holding is less likely than any focus alternative not holding.

This proposal would capture one of the two possible interpretations of (53b), namely the scalar one, where Lea did the homework, she did something else as well, and Lea doing the homework was the least likely thing she could do. As for (54b), its scalar interpretation corresponds to: it is not the case that Lea did the homework, it is not the case that she did something else, and Lea not doing the homework was the least expected thing.

What is the link between the ONLY and the EVEN-exhaustification? In other words, why are these two mechanisms united in different interpretations of the same expressions? At first glance, there is nothing connecting the two types of exhaustification or the natural language expressions they are modelled after ('only' and 'even'). But notice that 'only' can acquire emphasis and receive a richer meaning than the one that is canonically attributed to it:

(58) I can only imagine what it looked like!

(59) He managed to read only one book (out of 50 that were on the list)!

In the above examples we see that the focus particle 'only' can, in addition to its regular exceptive meaning, implicate that the alternative that constitutes the assertion is the most likely. It means that this focus particle is also capable of expressing scalar ordering between different alternatives, under heavy emphasis, although it represents the mirror image of 'even' in positive contexts ('least likely' vs. 'most likely'). However, in the case of additive focus particles *ni* ('either') and *i* ('also'), we are not dealing with an overt 'only' particle, but with an 'only'-like exhaustification whose mechanism is fixed (40). It is thus still unclear how the switch from ONLY to EVEN exhaustification happens in one and the same item, if their mechanisms are fixed and essentially different form each other (with or without a probability measure).

5. Conclusions

This paper tried to provide a unified analysis for *ni* as a coordination marker and *ni* as a focus particle, since the source of their polarity sensitivity is identified as the same — their disjunctive nature in combination with the sets of alternatives they obligatorily introduce. Serbian particle *ni* is analyzed as a strong NPI disjunction that is always found in the scope of a negative operator and whose alternatives must be exhaustified. Scope diagnostics with necessity modals and quantificational adverbs provide additional evidence for the disjunction-based analysis of *ni*. Its polarity sensitive behavior results from its lexical specification — the particle must agree with a c-commanding silent operator, which makes the subdomain and scalar alternatives active and subject to exhaustification. The present account of different roles in grammar performed by *ni* is related to the distributionally non-restricted conjunction *i*, which also acts as an additive and a scalar focus particle.

The paper shows, on the case of *ni*, that an alternatives and exhaustification approach can also be useful for analyzing polarity sensitive coordination markers. Crucially, it fits with the rest of the framework, since the lowest scalar elements exhibit negative polarity in all described cases (indefinites, modals, and now a disjunction).

Diachronic studies in the field of coordination strategies cross-linguistically report a common additive origin for a number of Indo-European conjunctions and additive particles (Goldstein (2016)), Old Church Slavonic *i* being among them. The reasoning is the following: if the additive particle is indeed a binary operator, as soon as the antecedent of the silent anaphor is immediately preceding the host in the discourse, the additive particle is easily reanalyzed as a conjunction. However, the opposite reasoning could also hold — such particles are used as coordinators at first (as advanced by Szabolcsi (2016)), and once the structure is left with only one member of the coordination, another one must be understood as silent, in order to rescue the meaning of the sentence.

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A uniqueness puzzle: *How many*-questions and non-distributive predication[1]

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Abstract. We discuss a novel observation about the meaning of *how many*-questions, viz. a uniqueness implication that arises in cases that feature non-distributive predicates, such as *How many students solved this problem together?*. We attempt an analysis of this effect in terms of Dayal's (1996) *Maximal Informativity Presupposition* for questions. We observe that such an analysis must be reconciled with the unexpected absence of uniqueness implications in cases where the non-distributive predicate appears under a possibility modal. We explore two possible solutions: (i) the postulation of a scopally mobile maximality operator in degree questions of the sort proposed in Abrusán and Spector (2011); (ii) the proposal that the informativity to be maximized is based on pragmatic, contextual, entailment rather than semantic entailment. We explain why neither solution is satisfactory. We also observe that a Maximal Informativity Presupposition fails to capture uniqueness implications in *how many*-questions with predicates that are weakly distributive in the sense of Buccola and Spector (2016), such as *How many students in the seminar have the same first name?*. We conclude that uniqueness implications in *how many*-questions must have a source that is independent of Dayal's (1996) Maximal Informativity Presupposition.

Keywords: *how many*-questions, uniqueness presuppositions, non-distributive predication, Maximal Informativity Presupposition.

1. Introduction

Recent work posits that questions come with a *Maximal Informativity Presupposition* (MIP, Dayal 1996). The MIP is stated informally in (1), where an answer is to be understood as a member of the question extension under the Hamblin/Karttunen analysis of questions, the set of so-called Hamblin/Karttunen answers (Hamblin 1973, Karttunen 1977).

(1) Maximal Informativity Presupposition (MIP)
A question presupposes that it has a true answer that semantically entails any other true answer.

Dayal (1996) proposed the MIP in order to capture the uniqueness presupposition carried by singular *which* questions. It has since played a prominent role in the analysis of so-called weak islands (Fox and Hackl 2006, Schwarz and Shimoyama 2011, Abrusán and Spector 2011, Abrusán 2011, 2014).

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In this paper, we discuss a phenomenon which, at first sight, is naturally interpreted as another symptom of the MIP, viz. uniqueness presuppositions that arise from *how many*-questions with non-distributive predicates. The phenomenon is illustrated by (2).

(2) How many students solved this problem together?

A questioner who already assumes that two or more student groups of different sizes solved the problem will not consider (2) a fully appropriate vehicle for requesting information about the exact sizes of those groups; and an addressee who believes that two or more student groups of different sizes solved the problem will likewise judge (2) as not fully appropriate. In short, the question is judged to carry the presupposition that there is a unique size of student groups who solved this problem.[2]

Under familiar assumptions about *how many*-questions (Beck and Rullmann 1999), the set of Hamblin/Karttunen answers to (2) contains, for any cardinality n, the propositions that there is a group of n students who solved this problem together. We note that none of these Hamblin/Karttunen answers are related by semantic entailment. For different cardinalities n and m, the propositions that there is a group of n students who solved this problem together and the propositions that there is a group of m students who solved this problem together are semantically independent. As a consequence, the MIP is true if and only if exactly one of these Hamblin/Karttunen answers is true, hence if and only if there is exactly one cardinality n such that there is a group of n students who solved this problem together. This straightforwardly captures the uniqueness effect described above, which therefore appears to present a novel instantiation the MIP in (1).

A puzzle arises under this analysis from the study of examples that feature modal operators. In (3), example (1) is modified by embedding the wh-phrase's scope under the deontic possibility modal *allowed*. Clearly, this question does *not* presuppose that there is only one cardinality n such that it is allowed that a group of n students solves this problem.

(3) How many students are allowed to solve this problem together?

Yet this unattested uniqueness presupposition is precisely what the MIP derives. The reason is that in this case, too, the Hamblin/Karttunen answers are not related by entailment. For different cardinalities n and m, the propositions that it is allowed for n students to solved this problem together and the propositions that it is allowed for m students to solved this problem together are again semantically independent. What, then, accounts for the contrast between (2) and (3)?

In this paper, we explore two answers to this question. The first answer enriches the syntax-semantics of *how many* questions by positing a scopally mobile maximality operator of the

[2]We are not the first to study *how many*-questions with non-distributive predicates (Beck and Rullmann 1999, Abrusán 2014). However, to our knowledge previous work confined attention to examples with possibility modals, such as Beck and Rullmann's example *How many people can play this game?*. As we will discuss shortly, possibility modals obviate the uniqueness effect just described, which explains why no uniqueness effects were reported in those works.

sort posited in Abrusán and Spector (2011); the second answer proposes that for the purposes of the MIP, the proper notion of informativity is contextually supported entailment rather than semantic entailment. Unfortunately, however, we find that both solutions fall short of properly characterizing the relevant data, mischaracterizing the conditions under which the uniqueness effect arises in (2) or (3). In addition, we observe that a Maximal Informativity Presupposition fails to capture uniqueness implications in *how many*-questions with predicates that are weakly distributive in the sense of Buccola (2015) and Buccola and Spector (2016), such as *How many students in the seminar have the same first name?*. We conclude that, despite initial appearance, uniqueness implications in *how many*-questions must have a source that is independent of Dayal's (1996) Maximal Informativity Presupposition.

2. On the syntax-semantics of *how many*-questions

We adopt assumptions about the syntax and semantics of *how many*-questions familiar from, for example, Beck and Rullmann (1999). We assign to our running example (2) the logical form in (4), where *spt* abbreviates *solved this problem together*.

(4) how λn[[$\exists$ [n many] students] spt]

In (4), the wh-phrase *how* has extracted from the argument position of *many*; wh-movement leaves behind a trace *n* ranging over degrees or, more specifically, cardinalities; the phrase *n many students* is taken to form an existential generalized quantifier, headed by the silent existential determiner $\exists$; finally, wh-movement of *how* creates a derived predicate of cardinalities.

Again following Beck and Rullmann (1999), we take *many* to denote a relation between cardinalities and individual sums in the sense of Link (1983), which for ease of exposition we also refer to as *groups*. (Note that a group may consist of just one atomic individual.) As shown in (5), we take *many* to relate a cardinality n to a group x just in case the cardinality of x (i.e., the number of atomic individuals in x) equals n.

(5) $[\![\textit{many}]\!] = \lambda n_d.\ \lambda x_e.\ \lambda w_s.\ |x| = n$

The lambda abstract in (4) will accordingly denote the property of cardinalities in (6), which maps any cardinality n to the proposition that there is a group of size n that solved this problem.

(6) $\lambda n_d.\ \lambda w_s.\ \exists x[[\![\textit{students}]\!](x)(w) \wedge [\![\textit{spt}]\!](x)(w) \wedge |x| = n]$

For ease of exposition, we adopt the so-called functional approach to the semantics of questions (Krifka 2011), that is, we assume that the property in (6) is also the denotation of the question in (2) as a whole. Under this assumption, the set of Hamblin/Karttunen answers to a *how many*-question (or any wh-question) is the set of propositions that forms the range of the question's denotation.

3. The uniqueness effect

Before we turn to the analysis of the uniqueness effect described in section 1, we briefly elaborate on the nature of this effect. According to our description above, (2) presupposes that there is a *unique size* of student groups that solved the problem together. However, some speakers judge (2) to even carry the presupposition that there is a *unique group* of students who solved the problem together. We will refer to these two presuppositions as the *uniqueness of size* and the *uniqueness of group* presupposition, respectively. Note that the uniqueness of group presupposition is stronger than the uniqueness of size presupposition: if there is only one group who solved the problem, then there is a unique size of student groups who solved it, viz. the size of that unique group; however, the reverse entailment does not hold, as there could be several groups of the same size who solved the problem.

Whether or not (2) indeed carries an (obligatory) uniqueness of group presupposition, we will in this paper focus on the weaker uniqueness of size presupposition, whose existence we take not to be in doubt. However, we will briefly return to the potential uniqueness of group presupposition, and its significance for the puzzle we describe, in section 9 at the very end of this paper.

4. An account of the uniqueness effect

For any given question, the MIP stated in (1) requires that the question have a true Hamblin/Karttunen answer that entails any other true Hamblin/Karttunen answer. Under the functional question semantics that we have adopted, the MIP can be characterized as the proposition that there is a true proposition in the question denotation's range that entails any other true answer in the range. This is stated in (7), where the variable x ranges over members of the domain of the question denotation, which in the case of *how many*-questions is the set of cardinalities.

(7) For any (functional) question denotation Q:
$\text{MIP}(Q) = \lambda w_s.\ \exists x[Q(x)(w) \wedge \forall y[Q(y)(w) \rightarrow Q(x) \subseteq Q(y)]\ ]$

We observed in section 1 that the Hamblin/Karttunen answers to (2) are not related by entailment. For the denotation in (6), this means that it is *non-ordering* in the sense of (8): no proposition in the question denotation's range entails any other proposition in that range.

(8) Non-orderingness
f is *non-ordering* $:\Leftrightarrow\ \ \forall x,y[f(x) \neq f(y) \rightarrow f(x) \nsubseteq f(y)]$

The denotation in (6) is non-ordering because, as noted, for different cardinalities n and m, the proposition that there is a group of n students that jointly solved this problem and the proposition that there is a group of m students that jointly solved this problem are semantically independent.

The central observation, as stated in (9), is now that for a non-ordering question denotation, the MIP encodes a uniqueness presupposition: if all the propositions in the range of the question denotation are unrelated by entailment, then the MIP requires that there be at most (and at least) one of them that is true.

(9) For any non-ordering question denotation Q:
$\text{MIP}(Q) = \lambda w_s.\ \exists x[Q(x)(w) \wedge \forall y[Q(y)(w) \rightarrow Q(x) = Q(y)]\ ]$

For (2), the MIP therefore yields the proposition that exactly one proposition in the range of (6) is true, which we can describe as in (10), as the proposition that there is exactly one cardinality n such that a group of n students solved this problem together. In other words, the MIP delivers the uniqueness of size presupposition described above.

(10) $\lambda w_s.\ \exists! n[\exists x[[\![\textit{students}]\!](x)(w) \wedge [\![\textit{spt}]\!](x)(w) \wedge |x|=n]\ ]$

Note that the non-orderingness of the denotation of (2) is due to the semantic behaviour of the predicate *solved this problem together*. The property expressed by this predicate is itself non-ordering: for any two distinct groups x and y, the proposition that the members of x solved the problem together fails to entail the proposition that the members of y solved the problem together.

Of course, not all predicates are non-ordering. To illustrate, we contrast (2) with (11), where *solved this problem together* is replaced by *laughed*.

(11) How many students laughed?

The properties expressed by *laugh* and *students* are distributive in the sense of (12), where $\sqsubseteq$ is the mereological part-of relation between groups of individuals. For any two groups of individuals x and y such that x is included in y, the proposition that y are students (or is a student) who laughed entails the proposition that x are students (or is a student) who laughed. This keeps the denotation of the logical form (13a), shown in (13b), from being non-ordering. In fact, distributivity ensures that (13b) is *downward scalar* in the sense of (14) (Beck and Rullmann 1999).[3]

(12) Distributivity
f is *distributive* $:\Leftrightarrow\ \forall x,y[x \sqsubseteq y \rightarrow f(y) \subseteq f(x)]$

(13) a. how λn[[$\exists$ [n many] students] laughed]
b. $\lambda n_d.\ \lambda w_s.\ \exists x[[\![\textit{students}]\!](x)(w) \wedge [\![\textit{laughed}]\!](x)(w) \wedge |x| = n]$

(14) Downward scalarity
f is *downward scalar* $:\Leftrightarrow\ \forall n,m[m \leq n \rightarrow f(n) \subseteq f(m)]$

[3]Since it presupposes reference to the intrinsic ordering of cardinalities or other degrees, the notion of downward scalarity selectively applies to the denotations *how many*-questions and other degree questions, not to question in general.

The denotation in (13b) is downward scalar because, given distributivity of *students* and *laughed*, the existence of a group of n students who laughed guarantees the existence of a group of m students who laughed, for any m≤n; hence for any such n and m, the proposition that there is a group of n students who laughed semantically entails the proposition that there is a group of m students who laughed. Consider now the set of cardinalities that a given downward scalar question denotation maps to a true proposition. Suppose that this set has a (unique) maximal element. The downward scalar function will map that maximal element to a proposition that entails all the other true propositions in its range, and hence the MIP will be met; so, as stated in (15), the MIP will merely require that the set of cardinalities that the question denotation maps to a true proposition have a maximal member in terms of the intrinsic ordering of cardinalities.

(15) For any downward scalar question denotation Q:
$\text{MIP(Q)} = \lambda w_s.\ \exists n[Q(n)(w) \wedge \forall m[Q(m)(w) \rightarrow m \leq n]\ ]$

But in order for a set of cardinalities to have a (unique) maximal member, all it takes is for that set to be non-empty and finite. Applied to the downward scalar denotation of (11) in (13b), the MIP therefore yields the proposition stated in (16), the presupposition that there is a group of students of some (finite) size who solved this problem together.

(16) $\lambda w_s.\ \exists n[\exists x[[\![\textit{students}]\!](x)(w) \wedge [\![\textit{laugh}]\!](x)(w) \wedge |x|=n]\ ]$

So in this case, the MIP amounts to a mere existence presupposition. The content of the MIP is predicted to be more obvious, however, in cases that feature non-ordering properties, as illustrated by the correctly predicted uniqueness of size presupposition for (2).

5. The puzzle: modal obviation of the uniqueness effect

Under the MIP-based account for the uniqueness of size presupposition in *how many*-questions, an interesting puzzle emerges from examples that feature modal expressions such as deontic *required* and *allowed*. Consider the pair of questions in (17), where (17b) repeats (3). Extrapolating from our analysis of (2), we arrive at assigning to these questions the logical forms in (18a) and (19a) and the denotations in (18b) and (19b).[4]

(17) a. How many students are required to solve this problem together?
b. How many students are allowed to solve this problem together?

(18) a. how λn[required [[∃ [n many] students] spt]]
b. $\lambda n_d.\ \lambda w_s.\ \forall v[v \in ACC(w) \rightarrow \exists x[[\![\textit{students}]\!](x)(v) \wedge [\![\textit{spt}]\!](x)(v) \wedge |x|=n]\ ]$

(19) a. how λn[allowed [[∃ [n many] students] spt]]
b. $\lambda n_d.\ \lambda w_s.\ \exists v[v \in ACC(w) \wedge \exists x[[\![\textit{students}]\!](x)(v) \wedge [\![\textit{spt}]\!](x)(v) \wedge |x|=n]\ ]$

[4]We only consider the "de dicto" readings of the relevant questions (Cinque 1990), where the existential generalized quantifier containing *many* plus modified noun is interpreted within the scope of the modal.

So, the denotation assigned to (17a), shown in (18b), maps any cardinality n to the proposition that in every permissible world, there is a group of students of size n who solved the problem together; likewise the denotation of (17b), shown in (19b), maps any cardinality n to the proposition that there is a permissible world in which there is a group of students of size n who solved the problem together. Note that the non-orderingness of the denotation of *solve this problem together* ensures that the question denotations in (18b) and (19b), too, are once again non-ordering. For any distinct cardinalities n and m, the proposition that in every permissible world there is a group of n students who solved the problem together does not entail the proposition that in every permissible world there is a group of m students who solved the problem together; likewise the proposition that there is a permissible world where a group of n students solved the problem together does not entail the proposition that there is a permissible world where a group of m students solved the problem together. This means that for both of those cases the MIP once again delivers a uniqueness presupposition. Given (18b), the MIP assigned to (17a), shown in (20a), is the proposition that that there is a unique cardinality such that a student group of that cardinality is required to solve the problem; and given (19b), the MIP assigned to (17b), shown in (20b), is the proposition that there is a unique cardinality such that a student group of that cardinality is allowed to solve the problem.

(20) a. $\lambda w_s.\ \exists!n[\forall v[v{\in}ACC(w) \rightarrow \exists x[[\![\mathit{students}]\!](x)(v) \wedge [\![\mathit{spt}]\!](x)(v) \wedge |x|{=}n]\ ]\ ]$
b. $\lambda w_s.\ \exists!n[\exists v[v{\in}ACC(w) \wedge \exists x[[\![\mathit{students}]\!](x)(v) \wedge [\![\mathit{spt}]\!](x)(v) \wedge |x|{=}n]\ ]\ ]$

For the question in (17a), this prediction appears adequate, supported by intuitions similar to those about the non-modal example in (2). A speaker using (17a) indeed seems to exclude the possibility of there being more than one cardinality such that it is required for a student group of that cardinality to solve the problem. However, for the question in (17b), the predicted uniqueness of size presupposition is clearly incorrect. The question can be used very naturally in contexts where there is assumed to be a range of permissible group sizes. For example, the interlocutors' common knowledge might entail that there is an upper bound on the permissible sizes, that this upper bound is between five and ten, and that there are no further constraints on permissible group sizes. In this case, common knowledge is consistent with there being between five and ten permissible sizes, and the speaker may use (17b) to obtain further information.

So the uniqueness effect is expectedly preserved under the addition of the necessity modal, but it is unexpectedly obviated by the addition of the possibility modal. How can this obviation effect of possibility modals be accounted for? In sections 6 and 7, we examine two different conceivable strategies to answer this question that preserve the idea that the uniqueness effect is due to to a maximal informativity presupposition.

6. First try: a maximality operator

We are not the first to encounter a problem of unwanted uniqueness presuppositions derived by the MIP. Abrusán and Spector (2011) describe much the same problem as they develop an analysis of degree questions that lets gradable predicates denote relations between individuals and intervals of degrees. Abrusán and Spector report that such an interval semantics comes into conflict with the assumption that questions carry a maximal informativity presupposition. For example, they report that under their interval-based analysis, a degree question like (21) is incorrectly assigned the MIP that there is only one length that the paper is allowed to have.

(21) How long is the paper allowed to be?

This presupposition is inconsistent with intuitions about (21), which clearly indicate that the question can be used in contexts where the paper is permitted to have a range of different lengths. For example, (21) can be used in a context where the interlocutors's common knowledge entails that there is an upper bound on the paper's permitted lengths, that this upper bound is somewhere between 10 and 20 pages, that there is a lower bound of 6 pages, and that there are no further constraints on the on permissible lengths. In such a scenario, common knowledge is consistent with there being between 5 and 15 different permitted paper lengths (measured in terms of numbers of pages). The speaker might then use (21) to obtain further information.

The problem that Abrusán and Spector (2011) describe is transparently analogous to our puzzle of modal obviation of the uniqueness of size effect in *how many*-questions. Therefore, since Abrusán and Spector offer a solution to the problem that arises in their interval semantics, one might hope that this solution is transferrable to our puzzle. That is the line of attack that we explore below.

Abrusán and Spector propose that gradable predicates (such as *long* or *many*) introduce a scopally mobile operator Π (first defined in Heim 2006) that creates derived properties of degrees. Here we minimally adapt Abrusán and Spector's semantics for Π to ensure consistency with our assumptions. We take Π to denote a Curryed version of a function from properties of cardinalities to properties of cardinalities, which relates any set of cardinalities that has a unique maximal member to the singleton set containing that maximal member. This denotation is spelled out in (22) (where *max* maps a set of cardinalities to its unique maximal member). We note that a nearly identical maximality operator has been employed for somewhat different purposes in Buccola and Spector (2016).

(22) $[\![\Pi]\!] = \lambda m_d.\ \lambda P_{d(st)}.\ \lambda w_s.\ \max\{n: P(n)(w)\} = m$

To illustrate the syntax and the semantic effect of Π, we return to the question in (11), repeated below in (23). As shown in (24a), we assume that Π enters the syntactic derivation as part of a phrase, the Π-*phrase*, that also includes the wh-phrase *how* and that sits in the argument position of *many*; in (24b), the Π-phrase has extracted from its base position to the edge of the sentence, forming a derived predicate of cardinalities in its scope; and in (24c), *how* has subextracted from the Π-phrase, once again forming a predicate of cardinalities in its scope.

(23) How many students laughed?

(24) a. [∃ [[Π how] many] students] laughed
b. [Π how] λn[[∃ [n many] students] laughed]
c. how λm[[Π m] λn[[∃ [n many] students] laughed]]

Given the denotation of Π shown in (22), the logical form in (24c) receives the denotation in (25). This question denotation maps any cardinality m to the proposition that m is the largest cardinality n such that there is a group of n students who laughed. More transparently, (25) maps any cardinality to the proposition that the set of all students who laughed has that cardinality.

(25) $\lambda m_d.\ \lambda w_s.\ \max\{n: \exists x[[\![\textit{students}]\!](x)(w) \wedge [\![\textit{laughed}]\!](x)(w) \wedge |x| = n]\} = m$

The propositions in the range of this function are mutually incompatible. For any distinct cardinalities n and m, the proposition that n is the number of all students who laughed contradicts the proposition that m is the number of all students who laughed. Therefore, the MIP derived from (25) is satisfied as long as there are (finitely many) students who laughed. Therefore, just like under the analysis in section 4 (where we appealed to the distributivity of the meaning of *laugh*) the MIP for (23) amounts to a mere existence presupposition.

For completeness, we note that (23) may well be considered ambiguous between the meaning in (25) and the meaning we derived in in section 3, shown in (13b). Repurposing related hypotheses entertained in Buccola and Spector (2016), we can see two possible ways of recovering (13b). One way is to assume that the presence of Π is optional and that (13a), too, is a well-formed logical form for (23). Another option is to assume that the Π-phrase can scope within the containing noun phrase, below the existential determiner ∃. As readers are invited to verify, with such narrow scope, the presence of Π winds up having no effect on the question denotation as a whole, replicating the meaning assigned to the logical form (13a), where Π is not present in the first place.

We are now ready to return to our problematic example (3), repeated again below in (26). We are focusing on a logical form for this question where the Π-phrase has moved past *allowed* to again take widest scope, turning (27a) into (27b), followed by short subextraction of *how*, yielding (27c). The denotation assigned to (27c) is shown in (28).

(26) How many students are allowed to solve this problem together?

(27) a. allowed [[∃ [[Π how] many] students] spt]
b. [Π how] λn[allowed [[∃ [n many] students] spt]]
c. how λm[[Π m] λn[allowed [[∃ [n many] students] spt]]]

(28) $\lambda m_d.\ \lambda w_s.\ \max\{n: \exists v[v \in ACC(w) \wedge \exists x[[\![\textit{st}]\!](x)(v) \wedge [\![\textit{spt}]\!](x)(v) \wedge |x|=n]\ ]\ \} = m$

This denotation maps any cardinality m to the proposition that m is the largest cardinality n such that in some permissible world, there is a group of n students who solved this problem together. More transparently, (28) maps any cardinality m to the proposition that m is the largest permitted size of groups of students that solve this problem. Since there can be at most one such largest permitted group size, the propositions in the range of (28) are again pairwise incompatible. Therefore, the MIP once again yields a mere existence presupposition, though in this case the presupposition that there is a *largest* permitted size of student groups solving the problem.

So the Π-phrase scoping over the possibility modal in (26) has the welcome effect of preempting the derivation of the unattested uniqueness of size presupposition, that is, the presupposition that there is a *unique* permitted size of student groups solving the problem. Moreover, the weaker MIP now derived for (26) appears weak enough to be consistent with intuitions about the meaning of the question.

This might be an encouraging finding, especially since the Π operator employed here, or some version of it, may have independent support from domains other than *how many*-questions (Heim 2006, Buccola and Spector 2016, Abrusán and Spector 2011, Kennedy 2015). However, there remains an obvious open question that the proposal as stated fails to answer. Why is the obviation of the uniqueness effect tied to the presence of a possibility modal? After all, one might expect that the questions in (2) and (17a), repeated below in (29a) and (29b), also allow for logical forms where the Π-phrase takes wide scope, that is, the logical forms in (30).

(29) a. How many students solved this problem together?
b. How many students are required to solve this problem together?

(30) a. how λm[[Π m] λn[[∃ [n many] students] spt]]
b. how λm[[Π m] λn[required [[∃ [n many] students] spt]]]

These logical forms, too, would preempt the uniqueness of size presuppositions described in sections 1, 3, and 5. The MIP that the logical form in (30a) would give rise to is the proposition that there is a *largest* size of student groups who solved the problem. But once again, this proposition amounts to a mere existence presupposition. Whenever there is at least one student group (of finite size) who solved the problem, there is guaranteed to be exactly one that is as large as any of the others. Hence the Π-phrase in (30a) incorrectly obviates the very uniqueness of size presupposition that served as the starting point of our investigation. Similarly, the MIP based on (30b) is the proposition that there is a *largest* cardinality such that it is required for there to be a student group of that cardinality that solves the problem. Once again, this is weaker than the uniqueness presupposition described above, namely the proposition that there is a unique required cardinality of student groups solving the problem.

Therefore, if a MIP-based account of the uniqueness effects in (29a) and (29b) is to be preserved, logical forms like those in (30) must be excluded as well-formed inputs to semantic interpretation. Unfortunately, however, there appears to be no independent rationale for such exclusion. In particular, it is not promising to explore the hypothesis that there is something wrong with the syntactic distance that the moving Π-phrase has travelled in the logical forms in (30), since an equal or greater distance is covered by the Π-phrase movement posited in the logical form in (27c). We conclude that, as long as the uniqueness of size effect is sought to be accounted for in terms of the MIP, the obviation of this effect by a scopally mobile Π-phrase must be excluded, which presumably requires excluding the logical form in (27c) along with those in (30). We then require a different account of the puzzling obviation of the uniqueness of size effect by possibility modals.

7. Second try: contextual entailment

Having reverted to the position that the relevant question denotations are as initially presented in sections 2 and 5, we now target the MIP itself for revision. Our formulation of the MIP in (7) above follows Dayal (1996) and subsequent literature in that it construes the relevant notion of informativity as semantic entailment. We will now explore the consequences of instead construing informativity for the purposes of the MIP as pragmatic, contextual, entailment. Let c be the context set in the sense of Stalnaker (1978). As stated in symbols in (31), we say that a proposition p contextually entails a proposition q in context set c just in case q is semantically entailed by p in conjunction with c.

(31) Contextual Entailment
$p \subseteq_c q \;:\Leftrightarrow\; p \cap c \subseteq q$

We use this definition to minimally revise the statement of the MIP in (7) as shown in (32), relativizing it to the context set and substituting contextual entailment for semantic entailment.

(32) For any (functional) question denotation Q and context set c:
$\text{MIP}_c(Q) = \lambda w_s.\ \exists x[Q(x)(w) \wedge \forall y[Q(y)(w) \rightarrow Q(x) \subseteq_c Q(y)]\ ]$

The immediate benefit of this revision is that the problematic modal obviation example in (3), repeated once more in (33), is no longer predicted to carry a uniqueness of size presupposition in all contexts.

(33) How many students are allowed to solve this problem together?

Under (32), the felicity of (33) is expected to be consistent with the existence of multiple true Hamblin/Karttunen answers, as long as there is one among them that contextually entails all the others. The most natural contexts of this sort are contexts that ensure that the denotation of (33) in (19b), repeated in (34), is *contextually scalar*.

(34) $\lambda n_d.\ \lambda w_s.\ \exists v[v \in \text{ACC}(w) \wedge \exists x[[\![\textit{students}]\!](x)(v) \wedge [\![\textit{spt}]\!](x)(v) \wedge |x|=n]\ ]$

The denotation in (34) is contextually scalar in the intended sense in contexts where the relative contextual strength of any two Hamblin/Karttunen answers is predictable from the intrinsic ordering of the two cardinalities that (34) maps to these propositions. In particular, (34) might be *contextually downward scalar* in the sense defined in (35).

(35) Contextual downward scalarity
f is *contextually downward scalar* in c $:\Leftrightarrow\; \forall n,m[m \leq n \rightarrow f(n) \subseteq_c f(m)]$

According to (35), the denotation (34) is contextually downward scalar in contexts where for any cardinalities n and m such that m≤n, the proposition that there are permissible worlds where a group of n students solves the problem contextually entails the proposition that there are permissible worlds where a group of m students solves the problem. In such a context, the truth of the contextual MIP for (33) merely requires that the set of permissible student group sizes have a unique maximal member. Assuming contextual downward scalarity, the proposition that (34) maps that maximal member to will be true and will contextually entail all the other true propositions in the range of (34).

We submit that contexts that make (34) contextually downward scalar are rather natural. Such a context could arise in a scenario where, for some cardinality n, the relevant authority, say, a university teacher, is known to have stated that groups of no more than n students may be formed to collaborate on solving this problem, and where it is moreover understood that there are no further restrictions on permitted group sizes. In such a scenario, the contextual downward scalarity of (34) is common knowledge: if it were to emerge, for example, that groups of five students are permitted, an interlocutor could justifiably infer that groups of four or less are permitted as well. A speaker who lacks complete information about the identity of n might appropriately use (33) in the hope of acquiring such information.

Once again, the obvious question is whether the approach under consideration captures our finding that the obviation of the uniqueness of size presupposition is only observed with possibility modals. The non-modal example (2) and the case with a necessity modal in (17a) are repeated again in (36), together with their denotations in (37), repeated from (6) and (18b).

(36) a. How many students solved this problem together?
b. How many students are required to solve this problem together?

(37) a. $\lambda n_d.\ \lambda w_s.\ \exists x[[\![\textit{students}]\!](x)(w) \wedge [\![\textit{spt}]\!](x)(w) \wedge |x| = n]$
b. $\lambda n_d.\ \lambda w_s.\ \forall v[v{\in}ACC(w) \rightarrow \exists x[[\![\textit{students}]\!](x)(v) \wedge [\![\textit{spt}]\!](x)(v) \wedge |x|{=}n]\ ]$

The expectation is, of course, that in the examples in (36), the uniqueness effect might disappear in suitable scenarios. The most plausible conceivable cases of this sort would again be scenarios that render the denotations in (37) contextually scalar. But now, again focusing on contextual downward scalarity, let us consider what such scenarios would be like.

For (37a), contextual downward scalarity would require a scenario where for any cardinalities n and m such that m≤n, the existence of a student group of size n who solved the problem contextually guarantees the existence of a student group of size m who solved the problem. In such a scenario, upon learning that there was a group of, say, six students who solved the problem together, one would be able to infer that there was also a group of five that did so, as well as a group of four, and so on. So in scenarios of this type, the existence of a group of n students who solved the problem would allow one to infer that there are at least n−1 other groups who did so as well, whose cardinalities moreover cover the entire range from 1 to n−1. We suggest that such a scenario is outlandish enough to not readily come to mind to speakers that interpret sentence (36a). The robustness of the uniqueness of size presupposition carried by

(36a) would then not be a matter of linguistic structure, but of the complexity and implausibility of the type of scenario under which that uniqueness presupposition would be weakened in the way it can be weakened in cases with possibility modals.

This line of analysis arguably accommodates the case of (36b), as well. For the denotation in (37b), contextual downward scalarity would require a scenario where for any cardinalities n and m such that m≤n, the proposition that a group of n students solved the problem in every permissible world contextually entails the proposition that a group of m students solved the problem in every permissible world. In such a scenario, upon learning that it is required for a group of n students to solve the problem, one would be justified in drawing the inference that it is also required that n−1 other groups of students solve the problem, whose cardinalities moreover must cover the entire range from 1 to n−1. Once again, we submit that such a scenario is sufficiently implausible to not readily come to mind to speakers judging the question in (36b), which serves to account for the robustness of the uniqueness effect in that example.

Thus, unlike our attempted account in terms of the Π-operator, the move to a revised MIP based on contextual entailment promises to capture the fact that the obviation of the uniqueness of size effect is limited to cases with a possibility modal.

Even so, we must report that, unfortunately, this account does not seem to fully capture the conditions on the use of the case with the possibility modal. While it affords a welcome weakening of the conditions on the use of (33), we can observe that this weakening does not go far enough. Consider a scenario where a teacher is known to have stipulated, for two different cardinalities n and m, that students must form groups to solve the problem together and that each group must have one of the sizes n and m. In this scenario, without having any further beliefs about the permitted group sizes, a speaker may felicitously use (33) to learn about the identity of n and m. Yet in this scenario, no contextual entailment holds between the proposition that a group of n students solves the problem in some permissible world and the proposition that a group of m students solves the problem in some permissible world. This scenario not only conflicts with the presupposition given by the original MIP in (7) but likewise with the weaker presupposition given by the revised MIP, based on contextual entailment.

So we are still left without a solution to the puzzle of modal obviation of the uniqueness of size effect. If we were to insist that this effect is a symptom of the MIP, we would still need to find a different way of understanding why the relevant *how many*-questions with possibility modals do not carry the expected presuppositions. In the next section, we present a type of *how many*-question that raises the reverse problem, by virtue of carrying a uniqueness of size presupposition that the MIP fails to derive.

8. Another problem: weak distributivity and weak downward scalarity

The *how many*-question in (38) gives rise to a similar observation as the question in (2) that we presented as our first illustration of the uniqueness of size presupposition. That is, (38) suggests that there is only one size of groups of students in the seminar that have the same first name.

(38) How many students in the seminar have the same first name?

In support of this assessment, we present two concrete scenarios in the form of the class rosters in (39). Imagine that (39a) is the roster for the seminar and that an addressee who has access to this information is presented with the question in (38). It seems clear that the addressee's cooperative response would be *three*, given that the class roster in (39a) shows a group of students with the same first name (viz. Ann), which has cardinality 3, and given that it does not show any other group of students that share their first name.

(39) a. Adams, Ann Durant, Bill
Baker, Ann Ellis, Chris
Collins, Ann Foster, Dan

b. Adams, Ann Durant, Bill
Baker, Ann Ellis, Bill
Collins, Ann Foster, Dan

In contrast, the class roster in (39b) shows a second group of students with the same first name (viz. Bill), which has cardinality 2. We submit that an addressee who has this information would be hard pressed to answer the question in (38). While such an addressee could truthfully assert that there are groups of two and three students with the same first name, the question in (38) does not appear to be a suitable vehicle for eliciting this information. Accordingly, a speaker who takes a class roster like (39b) to be a good possibility would presumably refrain from using (38) as a request for information. These observations confirm that (38) indeed carries a uniqueness of size presupposition.

Interestingly, however, this uniqueness of size presupposition cannot be understood as an instantiation of the MIP. This is a consequence of the semantic behaviour of the denotation of *have the same first name* and the denotation of the question in (38) as a whole. In contrast to the property expressed by *solve this problem together*, the property expressed by *have the same first name* is not non-ordering. For example, it is clear that the proposition that Adams, Baker, and Collins have the same first name semantically entails the proposition that Adams and Baker have the same first name. In fact, this example illustrates that the property expressed by *have the same first name* is weakly distributive in the sense of definition (40). That is, the property is distributive down to groups of at least two individuals: for any groups x and y such that x is included in y and x has cardinality 2 or more, the proposition that the individuals in y have the same first name semantically entails the proposition that the individuals in x have the same first name.[5]

(40) Weak distributivity
f is *weakly distributive* $:\Leftrightarrow \forall x,y[x \sqsubseteq y \wedge 2 \leq |x| \rightarrow f(y) \subseteq f(x)]$

[5] What keeps the property from being distributive simpliciter is that it does not apply to any atomic individuals. Setting aside the so-called discourse anaphoric reading of *same* (Beck 2000), the statement that, say, Adams has the same first name is not meaningful. That some collective predicates are weakly distributive in this way was observed in, e.g., Champollion (2010), Buccola (2015), and Buccola and Spector (2016), who illustrate the phenomenon with the verb *gather*. We borrow the term *weak distributivity* from Buccola and Spector (2016) (although in a slightly different meaning).

Under our current assumptions about the syntax and semantic of *how many*-questions, (38) has the logical form in (41a) and the denotation in (41b), where *hsfn* abbreviates *have the same first name*.

(41) a. how λn[[$\exists$ [n many] students] hsfn]
b. $\lambda n_d.\ \lambda w_s.\ \exists x[[\![\textit{students}]\!](x)(w) \wedge [\![\textit{hsfn}]\!](x)(w) \wedge |x| = n]$

The weak distributivity of the denotation of *have the same first name* (together with the distributivity of the denotation of *students*) guarantees that the question denotation in (41b) is *weakly downward scalar* in the sense of definition (42).

(42) Weak downward scalarity
f is *weakly downward scalar* $:\Leftrightarrow\ \forall n,m[m \leq n \wedge 2 \leq m \rightarrow f(n) \subseteq f(m)]$

That is, for any cardinalities n and m such that $m \leq n$ and $2 \leq m$, the proposition that a group of n students have the same first name semantically entails the proposition that a group of m students have the same first name.

For an argument that will be familiar from section 4, consider now the set of cardinalities (greater than 1) that a given weakly downward scalar question denotation maps to a true proposition. Suppose that this set has a (unique) maximal element. The weakly downward scalar function will map that maximal element to a proposition that entails all the other true propositions in its range, and hence the MIP will be met; so, as stated in (43), the MIP will merely require that the set of cardinalities that the question denotation maps to a true proposition have a (unique) maximal member in terms of the intrinsic ordering of cardinalities.

(43) For any weakly downward scalar question denotation Q:
$\text{MIP}(Q) = \lambda w_s.\ \exists n[Q(n)(w) \wedge \forall m[Q(m)(w) \rightarrow m \leq n]\ ]$

But, again, in order for any set of cardinalities to have a maximal member, all it takes is for that set to be non-empty and finite. Applied to the weakly downward scalar denotation of (38) in (41b), the MIP therefore yields the proposition stated in (44), the presupposition that there is a group of students in the seminar of some size (greater than 1 and finite) who have the same first name. So, just like questions with (strongly) downward scalar denotations, (38) winds up with a mere existential presupposition.

(44) $\lambda w_s.\ \exists n[\exists x[[\![\textit{students}]\!](x)(w) \wedge [\![\textit{hsfn}]\!](x)(w) \wedge |x|=n]\ ]$

This result entails that the MIP does not capture the uniqueness of size presupposition of (38), identified above. In the scenario (39b), for example, the MIP of (38) would be satisfied. In this scenario, the question has two true Hamblin/Karttunen answers, viz. the proposition that there is a group of two students who have the same first name and the proposition that there is a group of three students who have the same first name. MIP is satisfied in this scenario because, due to the weak distributivity of the property of having the same first name, the latter proposition semantically entails the former.

We conclude that for *how many*-questions with weakly distributive predicates, a MIP-based account delivers a presupposition that is too weak to capture the attested uniqueness effect.

9. Conclusion

To recap, we described a uniqueness presupposition carried by certain *how many*-questions with non-distributive predicates, such as *solve this problem together*. We explored an approach to this uniqueness effect that credits it to (a version of) Dayal's (1996) Maximal Informativity Presupposition (MIP). However, we found two symmetric problems for this approach. (i) The MIP derives an overly strong presupposition for *how many*-questions where a non-distributive predicate is embedded under a possibility modal. For such cases, the MIP is very obviously inadequate when informativity is construed as semantic entailment, and substituting contextual entailment for semantic entailment does not go far enough in weakening the MIP. We saw that a Π-operator which can outscope the possibility modal would weaken the MIP sufficiently to be consistent with intuitions; but such a Π-operator would be expected to incorrectly remove the uniqueness effect across the board, and leave one without an explanation for why the effect is ever observed to begin with. (ii) The MIP derives a presupposition that is to weak for *how many*-questions with a weakly distributive predicate.

Our finding about *how many*-questions with a weakly distributive predicate brings us back to our discussion of the uniqueness effect in section 3. There we noted that some speakers report that the question in (2), repeated one more time in (45a), does not merely carry a uniqueness of size presupposition, but a stronger uniqueness of group presupposition. That is, the relevant speakers take (45a) to presuppose that there is a unique group of students who solved the problem together. We suspect that this observation extends to (38), repeated in (45b), that is, that (45b) is naturally read as presupposing that there is only one group of students in the seminar that have the same first name.

(45) a. How many students solved this problem together?
b. How many students in this seminar have the same first name?

So, at least for some speakers, the MIP-based approach delivers presuppositions that are overly weak in two different ways. It fails to derive attested uniqueness of size presuppositions in *how many*-questions with certain collective predicates, and it fails to derive uniqueness of group presuppositions across the board.

The problem of predicted presuppositions being too weak becomes even more pronounced under a recent proposal in Fox (2013). In the context of analyzing so-called mention-some readings of questions, Fox proposes a revision of Dayal's (1996) definition of the MIP. Translated into our format, Fox proposes to replace Dayal's MIP in (7), repeated in (46), with the weaker version in (47).

(46) For any (functional) question denotation Q:
$\mathrm{MIP(Q)} = \lambda w_s.\ \exists x[Q(x)(w) \wedge \forall y[Q(y)(w) \rightarrow Q(x) \subseteq Q(y)]\ ]$

(47) For any (functional) question denotation Q:
$\mathrm{MIP}(Q) = \lambda w_s.\ \exists x[Q(x)(w) \wedge \neg\exists y[Q(y)(w) \wedge Q(x) \supset Q(y)]\ ]$

The MIP as defined in (46) requires that the set of true Hamblin/Karttunen answers have a member that is maximal in terms of the ordering given by semantic entailment, that is, a member that entails any other member. This maximal member is necessarily unique. Hence according to (46) the MIP excludes the existence of two true Hamblin/Karttunen answers that are not related by entailment. In contrast, the MIP defined in (47) merely requires that the set of true Hamblin/Karttunen answers have *at least one* maximal element in terms of the ordering given by semantic entailment, that is, at least one member that is not entailed by any other member. This allows for the existence of two true Hamblin/Karttunen answers that are not related by entailment.

Recall now that in all of the *how many*-questions with a non-distributive predicate like *solve this problem together*, the Hamblin/Karttunen answers are semantically unrelated. But that means that for those questions, the MIP as defined in (47) will amount to a mere existence presupposition, requiring that the question have at least one true Hamblin/Karttunen answer. Hence the weak MIP does not derive a uniqueness of size presupposition, let alone a uniqueness of group presupposition, for any of the questions we have studied in this paper.

In all, the negative results that we have reported suggest that the uniqueness of size effect we set out to understand is after all not a symptom of the MIP, and that an alternative account of this effect is to be sought, one that also captures uniqueness of group presuppositions and that extends to *how many*-questions with weakly distributive predicates. We must leave the development of such an alternative account to future work. But we will conclude by pointing to one possible approach that may have some promise: We have analyzed *many* as a relational adjective, which combines with a cardinality denoting expression to form an intersective modifier. In contrast, Hackl (2000) proposes that *many* is a so-called parametrized determiner. Hackl takes this determiner to have existential quantificational force. Adapting Hackl's proposal, one could think of *many* as being more similar to a singular definite article in that it triggers a presupposition of uniqueness. Uniqueness presuppositions would then be contributed by conventional lexical meaning, and would not be tied to the interpretation of questions in the way they are under the approach explored in this paper. We hope to spell out and evaluate this idea in future work.

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Incrementality and Clarification/Sluicing potential[1]

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Abstract. Incremental processing at least as fine grained as word-by-word has long been accepted as a basic feature of human processing of speech (see e.g., Schlesewsky and Bornkessel (2004)) and as an important feature for design of spoken dialogue systems (see e.g., Schlangen and Skantze (2009); Hough et al. (2015)). Nonetheless, with a few important exceptions (see e.g., Kempson et al. (2016)), incrementality is viewed as an aspect of performance, not semantic meaning. Moreover, it seems to entail giving up on compositionality as a constraining principle on denotations. In this paper, we point to a variety of dialogical phenomena whose analysis incontrovertibly requires a semantics formulated in incremental terms. These include cases, above all with sluicing, that call into question existing assumptions about ellipsis resolution and argue for incremental updating of QUD. The incremental semantic framework we sketch improves on existing such accounts (reviewed in Peldszus and Schlangen (2012); Hough et al. (2015)) on both denotational and contextual fronts: the contents we posit are in fact tightly constrained by a methodological principle more restrictive than traditional compositionality, namely the Reprise Content Hypothesis (Purver and Ginzburg (2004); Ginzburg and Purver (2012); Cooper (2013a)), embedded within independently motivated dialogue states (Ginzburg (2012)).

Keywords: Incremental processing, dialogue, clarification potential, sluicing

1. Introduction

Incremental processing at least as fine grained as word-by-word has long been accepted as a basic feature of human processing of speech (see e.g., Schlesewsky and Bornkessel (2004)) and as an important feature for design of spoken dialogue systems (see e.g., Schlangen and Skantze (2009); Hough et al. (2015)). Nonetheless, with a few important exceptions (see e.g., Kempson et al. (2016)), incrementality is viewed as an aspect of performance, not semantic meaning. Moreover, it seems to entail giving up on compositionality as a constraining principle on denotations. In this paper, we point to a variety of dialogical phenomena whose analysis incontrovertibly requires a semantics formulated in incremental terms. These include cases, above all with sluicing, that call into question existing assumptions about ellipsis resolution and argue for incremental updating of QUD. The incremental semantic framework we sketch improves on existing such accounts (reviewed in Peldszus and Schlangen (2012); Hough et al.

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(2015)) on both denotational and contextual fronts: the contents we posit are in fact tightly constrained by a methodological principle more restrictive than traditional compositionality, namely the Reprise Content Hypothesis (Purver and Ginzburg (2004); Ginzburg and Purver (2012); Cooper (2013a)), embedded within independently motivated dialogue states (Ginzburg (2012)).

The structure of the paper is as follows: in section 2 we introduce the data and draw from it basic specifications for incremental semantics. In section 3 we present the necessary background concerning KOS and Type Theory with Records, the frameworks we employ for representing dialogue, grammar, and semantics. In section 4, we sketch an account of dialogical incremental processing, which we apply to the data from section 2 in section 5. We end with some brief conclusions.

2. Why Semantics needs Incrementality : the Data and Initial specification

(1) exemplifies the fact that at any point in the speech stream of A's utterance B can interject with an acknowledgement whose force amounts to B understanding the initial segment of the utterance (Clark (1996)):

(1) A: Move the train . . . B: Aha A: . . . from Avon . . . B: Right A: . . . to Danville. (Trains corpus)

(1) requires us to be able to write a lexical entry for 'aha' and 'yeah' (and their counterparts cross linguistically, e.g., French: 'ouais', 'mmh',. . . ,) whose context is/includes "an incomplete utterance". (2a,b,c) exemplify a contrast between three reactions to an 'abandoned' utterance: in (2a) B asks A to elaborate, whereas in (2b) she asks him to complete her unfinished utterance; in (2c) B indicates that A's content is evident and he need not spell it out:

(2) a. A(i): John . . . Oh never mind. B(ii): What about John/What happened to John? A: He's a lovely chap but a bit disconnected. / # burnt himself while cooking last night.
b. A(i): John . . . Oh never mind. B(ii): John what? A: # He's a lovely chap but a bit disconnected. / burnt himself while cooking last night.
c. A: Bill is . . . B: Yeah don't say it, we know.

(2a,b,c) requires us to associate a content with A's incomplete utterance which can either trigger an elaboration query (2a), a query about utterance completion (2b), or an acknowledgement of understanding (2c). (3) is an attested example of an abandoned utterance in mid-word:

(3) [Context: A is in the kitchen searching for the always disappearing scissors. As he walks towards the cutlery drawer he begins to make his utterance, before discovering the scissors once the drawer is opened.] A: Who took the sci-. . .

(3) requires us to integrate within-utterance and (in this case, visual) dialogue context processing.

(4) exemplifies two types of expressions—filled pauses and exclamative interjections—that can in principle, be inserted at any point in the speech stream of A's utterance; the interjection 'Oh God' here reacts to the utterance situation conveyed incrementally.

(4) Audrey: Well it's like th- it's like the erm (pause) oh God! I've forgotten what it's bloody called now? (British National Corpus)

(4) requires us to enable the coherence of a question about what word/phrase will follow, essentially at any point in the speech stream; It also requires us to enable the coherence of an utterance expressing negative evaluation of the current incomplete utterance. (5a-e) illustrate that an incomplete clause can serve as an antecedent for a sluice, thereby going against the commonly held assumption that sluicing is an instance of 'S-ellipsis' (Merchant (2001)):

(5) a. The translation is by—who else?—Doris Silverstein (The TLS, Feb 2016)
b. He saw—can you guess who?—The Dude;
c. Queen Rhonda is dead. Long live . . . who? (New York Times, Nov 2015);
d. A: A really annoying incident. Some idiot, B: Who? A: Not clear. B: OK A: has taken the kitchen scissors.
e. A: Someone I'm not saying who / B: No, do say/Who?

(5) requires us to enable either incomplete argument frames or QNPs immediately after their utterance to trigger sluices.

3. Background

3.1. KoS

For our dialogical framework we use KoS (Ginzburg (1994); Larsson (2002); Purver (2006); Ginzburg (2012). KoS provides a cognitive architecture in which there is no single common ground, but distinct yet coupled Dialogue GameBoards, one per conversationalist. The structure of the dialogue gameboard (DGB) is given in table 1. The *Spkr* and *Addr* fields allow one to track turn ownership; *Facts* represents conversationally shared assumptions; *VisualSit* represents the dialogue participant's view of the visual situation and attended entities; *Pending*, the nature of which we explicate in more detail below, represents moves that are in the process of being grounded and *Moves* represents moves that have been grounded; *QUD* tracks the questions currently under discussion, though not simply questions *qua* semantic objects, but pairs of entities which we call *InfoStrucs*: a question and an antecedent sub-utterance.[2] This latter entity provides a partial specification of the focal (sub)utterance, and hence it is dubbed the *focus establishing constituent* (FEC). This is similar to the *parallel element* in higher order unification-based approaches to ellipsis resolution e.g. Gardent and Kohlhase (1997); and to Vallduví (2015), who relates the focus establishing constituent with a notion needed to capture *contrast*.

[2]Extensive motivation for this view of QUD can be found in (Fernández, 2006; Ginzburg, 2012), based primarily on semantic and syntactic parallelism in non-sentential utterances such as short answers, sluicing, and various other non-sentential utterances.

Dialogue Gameboard		
component	*type*	*keeps track of*
Spkr	Individual	*Turn*
Addr	Individual	*ownership*
utt-time	Time	
Facts	Set(propositions)	*Shared assumptions*
VisualSit	Situation	*Visual scene*
Moves	List(Locutionary propositions)	*Grounded utterances*
QUD	Partially ordered set($\langle$question, FEC$\rangle$)	*Live issues*
Pending	List(Locutionary propositions)	*Ungrounded utterances*

Table 1: Dialogue Gameboard

3.2. TTR

The logical underpinnings of KoS is Type Theory with Records (TTR) (Cooper (2012); Cooper and Ginzburg (2015)). TTR is a framework that draws its inspirations from two quite distinct sources. One source is Constructive Type Theory for the repertory of type constructors, and in particular records and record types, and the notion of witnessing conditions. The second source is situation semantics (Barwise (1989)) which TTR follows in viewing *semantics as ontology construction*. This is what underlies the emphasis on specifying structures in a model theoretic way, introducing structured objects for explicating properties, propositions, questions etc. It also takes from situation semantics an emphasis on *partiality* as a key feature of information processing. This aspect is exemplified in a key assumption of TTR—the witnessing relation between records and record types: the basic relationship between the two is that a record r is of type RT if each value in r assigned to a given label l_i satisfies the typing constraints imposed by RT on l_i:

(6) record witnessing

The record:

$$\begin{bmatrix} l_1 & = & a_1 \\ l_2 & = & a_2 \\ \ldots & & \\ l_n & = & a_n \end{bmatrix} \text{ is of type: } \begin{bmatrix} l_1 & : & T_1 \\ l_2 & : & T_2(l_1) \\ \ldots & & \\ l_n & : & T_n(l_1, l_2, \ldots, l_{n-1}) \end{bmatrix} \text{ iff } a_1 : T_1, a_2 : T_2(a_1), \ldots, a_n : T_n(a_1, a_2, \ldots, a_{n-1})$$

This allows for cases where there are fields in the record with labels not mentioned in the record type. This is important when e.g., records are used to model contexts and record types model rules about context change—we do not want to have to predict in advance all information that could be in a context when writing such rules.

For what follows, we require use of an analog to priority unification for record types in *asymmetric merge* (Cooper, 2012; Hough, 2015) defined as: given two record types $R1$ and $R2$,

$R1 \boxed{\dot{\wedge}} R2$ will yield a record type which is the union of all fields with labels not shared by R1 and R2 and the asymmetric merge of the remaining fields with the same labels, whereby R2's type values take priority over R1's fields, yielding a resulting record type with R2's fields only in those cases.

(7) Asymmetric Merge
$$\begin{bmatrix} \text{a}:T_1 \\ \text{b}:T_2 \\ \text{c}:T_3 \end{bmatrix} \boxed{\dot{\wedge}} \begin{bmatrix} \text{b}:T_2 \\ \text{c}:T_4 \end{bmatrix} = \begin{bmatrix} \text{a}:T_1 \\ \text{b}:T_2 \\ \text{c}:T_4 \end{bmatrix}$$

3.2.1. Conversational Rules

Context change is specified in terms of *conversational rules*, rules that specify the *effects* applicable to a DGB that satisfies certain *preconditions*. This allows both illocutionary effects to be modelled (preconditions for and effects of greeting, querying, assertion, parting etc.), interleaved with *locutionary effects*. We mention here three rules used subsequently. The first two concern the incrementation of QUD. (8a)[3] specifies that given the LatestMove being q, q becomes maximal in QUD, whereas (8b) concerns the effect of A asserting p: this raises the issue p?—the responder can then either decide to discuss this issue (as a consequence of the rule QSPEC introduced below as (9)) or accept it as positively resolved (as a consequence of a rule we do not mention here):

(8) a. Ask QUD-incrementation b. Assertion QUD-incrementation

$$\begin{bmatrix} \text{pre} = & \begin{bmatrix} \text{q}: & \textit{Question} \\ \text{LatestMove} = \text{Ask(spkr,addr,q)}: & \textit{IllocProp} \end{bmatrix} \\ \text{effects} = & \begin{bmatrix} \text{qud} = \left\langle \text{q},r^*.\text{qud} \right\rangle: & \text{poset}(\textit{Question}) \end{bmatrix} \end{bmatrix} \begin{bmatrix} \text{pre} = & \begin{bmatrix} \text{p}: & \textit{Prop} \\ \text{LatestMove} = \text{Assertion(spkr,addr,p)}: & \textit{IllocProp} \end{bmatrix} \\ \text{effects} = & \begin{bmatrix} \text{qud} = \left\langle \text{p?},r^*.\text{qud} \right\rangle: & \text{poset}(\textit{Question}) \end{bmatrix} \end{bmatrix}$$

QSPEC is KoS' version of Gricean Relevance—it characterizes the contextual background of reactive queries and assertions. QSPEC says that if q is QUD-maximal, then subsequent to this either conversational participant may make a move constrained to be q-specific (i.e. either a partial answer or sub-question of q).[4]

[3]Throughout in update rules we will use r^* to refer to the immediately preceding information state which is required to be of the type in the field labelled by 'pre' or 'preconditions'.

[4]We notate the underspecification of the turn holder as *TurnUnderspec*, an abbreviation for the following specification which gets unified together with the rest of the rule:

$$\begin{bmatrix} \text{PrevAud} = \left\{\text{pre.spkr,pre.addr}\right\} & : & \text{Set(Ind)} \\ \text{spkr} & : & \text{Ind} \\ \text{c1} & : & \text{member(spkr, PrevAud)} \\ \text{addr} & : & \text{Ind} \\ \text{c2} & : & \text{member(addr, PrevAud)} \\ & & \wedge\ \text{addr} \neq \text{spkr} \end{bmatrix}$$

(9) QSPEC

$$\left[\begin{array}{l} \text{pre} = \left[\text{qud} = \left\langle \text{i, I} \right\rangle\text{: poset}(\textit{InfoStruc})\right] \\ \text{effects} = \textit{TurnUnderspec} \\ \boxed{\wedge} \left[\begin{array}{l} \text{r} : \textit{AbSemObj} \\ \text{R}: \textit{IllocRel} \\ \text{LatestMove} = \\ \text{R(spkr,addr,r)} : \textit{IllocProp} \\ \text{c1} : \text{Qspecific(r,i.q)} \end{array}\right] \end{array}\right]$$

Update procedure: Using asymmetric merge, we employ the following update process for a dialogue context C and for some rule R, a record of type (10).

(10)
$$\left[\begin{array}{lll} \text{pre} & : & \textit{RecType} \\ \text{effects} & : & \textit{RecType} \end{array}\right]$$

When updating from one context C_i to the next C_{i+1} with rule R:

(11) If $C_i : T_{C_i}$ and T_{C_i} is a subtype of R.pre,
then R licenses the conclusion that:
$C_{i+1} : T_{C_i} \boxed{\wedge} R$.effects

The updates operate on various levels of information which can be arbitrarily fine-grained (even phonetic). This gives us the requisite apparatus for the incrementality discussed in section 2.

3.3. The Reprise Content Hypothesis and Generalized Quantifiers

As a means of tightly constraining semantic denotations, we adopt the Reprise Content Hypothesis (RCH, Purver and Ginzburg, 2004; Ginzburg and Purver, 2012; Cooper, 2013a):

(12) *A fragment reprise question queries exactly the standard semantic content of the fragment being reprised.*

This uses the data from responses to clarification questions about a constituent as indicative of its content (e.g., *A: Most students object to the proposal. B: Most students? A: Carl, Max, and Minnie.*). Purver and Ginzburg (2004) and Ginzburg and Purver (2012) use such data to argue in favour of witness sets rather than higher order entities as denotations of QNPs, whereas Cooper (2013a) refines Purver and Ginzburg's account and shows how the RCH can be maintained using a GQ-based perspective. Using the RCH as a methodological principle for positing denotations can be applied straightforwardly in an incremental setting. It offers a stronger constraint than Fregean/Montogovian compositionality which leaves underdetermined which part contributes what—it fulfills the criteria of what Milward (1991) calls *incremental representation* and *strongly incremental interpretation*.

3.4. Grounding/Clarification interaction Conditions

Much recent work in dialogue has emphasized two essential branches that can ensue in the aftermath of an utterance:

- **Grounding**: the utterance is understood, its content is added to common ground, uptake occurs.
- **Clarification Interaction**: some aspect of the utterance causes a problem; this triggers exchange to repair problem.

KoS's treatment of repair involves two aspects. One is straightforward, drawing on an early insight of Conversation Analysis (Schegloff (2007)), namely that repair can involve 'putting aside' an utterance for a while, a while during which the utterance is repaired. That in itself can be effected without further ado by adding further structure to the DGB, specifically the field introduced above called *Pending*. 'Putting the utterance aside' raises the issue of *what is it that we are 'putting aside?'*. In other words, how do we represent the utterance? The requisite information needs to be such that it enables the original speaker to interpret and recognize the coherence of the range of possible clarification queries that the original addressee might make. Ginzburg (2012) offers detailed arguments on this issue, including considerations of the phonological/syntactic parallelism exhibited between CRs and their antecedents and the existence of CRs whose function is to request repetition of (parts of) an utterance. Taken together with the obvious need for *Pending* to include values for the contextual parameters specified by the utterance type, Ginzburg concludes that the type of *Pending* combines tokens of the utterance, its parts, and of the constituents of the content with the utterance type associated with the utterance. An entity that fits this specification is the *locutionary proposition* defined by the utterance. A locutionary proposition is a proposition whose situational component is an utterance situation, typed as in (13a) and will have the form of record (13b):

(13) a. $LocProp =_{def} \begin{bmatrix} \text{sit} : Sign \\ \text{sit-type} : RecType \end{bmatrix}$ b. $\begin{bmatrix} \text{sit} = u \\ \text{sit-type} = T_u \end{bmatrix}$

Here T_u is a grammatical type for classifying u that emerges during the process of parsing u. It can be identified with a *sign* in the sense of Head Driven Phrase Structure Grammar (HPSG, Pollard and Sag, 1994). This is operationalized as follows: given a presupposition that u is the most recent speech event and that T_u is a grammatical type that classifies u, a record p_u of the form (13b), gets added to *Pending*. The two branches lead to the following alternative updates:

- Grounding, utterance u understood: update MOVES with p_u and respond appropriately (with the second half of an adjacency pair etc.)
- Clarification Interaction:

    1. p_u remains for future processing in PENDING;
    2. CQ(u), a clarification question calculated from p_u, updates QUD and CQ(u) becomes a discourse topic.

4. An incremental perspective on grounding and clarification

4.1. Incrementalizing dialogue processing

The account in section 3.4 was extended to self-repair in Ginzburg et al. (2014): the basic idea is simply to incrementalize the perspective from the turn level to the word level: as the utterance unfolds incrementally there potentially arise questions about what has happened so far (e.g. *what did the speaker mean with sub-utterance u1*?) or what is still to come (e.g. *what word does the speaker mean to utter after sub-utterance u2*?). These can be accommodated into the context if either uncertainty about the correctness of a sub-utterance arises or the speaker has planning or realizational problems. Overt examples for such accommodation are provided by self-addressed questions (*She saw the … what's the word?, Je suis comment dire?*), as explained below.

The account of Ginzburg et al. (2014) exemplified some incremental contents and explained a significant conceptual change that would need to be assumed—that *Pending* would have incremental utterance representations. It did not, however, begin to spell out concretely the nature of such representations, which are crucial in a third option a speaker has apart from grounding and (self)clarifying, namely *prediction* (see examples (2) and (3) above).

We can summarize this picture of processing as in (14), the monitoring and update/clarification cycle is modified to happen *at the end of each word utterance event*, and in case of the need for repair, a repair question gets accommodated into QUD.

(14) a. Ground: continue (Levelt (1983)).
b. Predict: stop, since content is predictable.
c. (Self)Clarify: generate CR given lack of expected utterance.

In the rest of this section we sketch an account of incremental utterance representations, including in particular incremental semantic contents.

4.2. Update Rules for specifying syntax

An essential presupposition of our approach (already in its non-incremental version, see above) is a view of syntax as speech event classification by an agent. For a very detailed exposition of such a view see Cooper (2016), a précis of which can be found in Cooper (2013b). Starting at the word level—if Lex(T_w, C) is one of the lexical resources available to an agent *A* (e.g., Lex('Beethoven', NP) or Lex('a', Det)) and *A* judges an event *e* to be of type T_w, then *A* is licensed to update their DGB with the type Lex(T_w,C). Intuitively, this means that if the agent hears an utterance of the word "composer", then they can conclude that they have heard a sign which has the category noun. This is the beginning of *parsing*, which Cooper shows how to assimilate to a kind of update akin to that involved in non-linguistic event perception such as route finding. The licensing condition corresponding to lexical resources like (14) is given in (15). We will return below to how this relates to gameboard update. (15) says that an agent with lexical resource Lex(T, C) who judges a speech event, u, to be of type T is licensed to judge that there is a sign of type Lex(T, C) whose 's-event.e'-field contains u.

(15) If Lex(T, C) is a resource available to agent A, then for any u, $u :_A T$ licenses $:_A$ Lex(T, C) $\boxed{\wedge}$ $\left[\text{s-event:}\left[\text{e}{=}u{:}T\right]\right]$

Strings of utterances of words can be classified as utterances of phrases. That is, speech events are hierarchically organized into types of speech events in a way akin to the complex event structures needed to model activities such as route finding. Agents have resources which allow them to reclassify a string of signs of certain types ("the daughters") into a single sign of another type ("the mother"). For instance, a string of type Det⁀N (that is, a concatenation of an event of type Det and an event of type N) can lead us to the conclusion that we have observed a sign of type NP whose daughters are of the type Det⁀N.

The resource that licences this is a rule which modelled as the function in (16a) which we represent as (16b).

(16) a. $\lambda u : Det^\frown N \,.\, NP \boxed{\wedge} \left[\text{syn:}\left[\text{daughters}{=}u{:}Det^\frown N\right]\right]$
b. RuleDaughters(NP, $Det^\frown N$)

'RuleDaughters' is to be the function in (17). Thus 'RuleDaughters', if provided with a subtype of $Sign^+$ and a subtype of *Sign* as arguments, will return a function which maps a string of signs of the first type to the second type with the restriction that the daughters field is filled by the string of signs:

(17) $\lambda T_1 : Type\,.$
$\lambda T_2 : Type\,.$
$\lambda u : T_1 \,.\, T_2 \boxed{\wedge} \left[\text{syn:}\left[\text{daughters}{=}u{:}T_1\right]\right]$

4.3. Semantic Composition using asymmetric merge

As we mentioned in section 3.2.1, we use asymmetric merge to integrate utterances into the DGB. We postulate as the denotation associated with the root of the tree the type *illocutionary proposition*, which is hence compatible with declarative, interrogative and imperative utterances. This gets refined as each word gets introduced using asymmetric merge, which enables us to effect a combinatory operation that synthesises function application and unification.

We exemplify how this works in explicating the evolution of the speaker's information state in example (3), repeated here as (18).

(18) [Context: J is in the kitchen searching for the always disappearing scissors. As he walks towards the cutlery drawer he begins to make his utterance, before discovering the scissors once the drawer is opened.] J: Who took the sci-. . .

Before the first word we assume that the speaker has the question ‘who took the scissors’ (which we denote here with q_0) on his agenda, in the private part of his information state;[5] in his visual field he can see no scissors:[6]

(19) InfState$_0$: T_0 where T_0 is

$$\begin{bmatrix} \text{private.agenda} = \left\langle \text{ask(s,q}_0\text{)} \right\rangle : \left\langle \mathit{Type} \right\rangle \\ \text{DGB.FACTS} = \left\{ \ldots \neg\exists x In(Vis - sit, x.scissors(x)) \ldots \right\} : \left\{ \mathit{Type} \right\} \end{bmatrix}$$

We assume that an utterance, u_1, of an interrogative NP such as *who* results in the update in (20). The content associated with the utterance involves *projection* in a sense we explicate shortly. Here it is projected to be a question of type *WhPQ* as in (20), a function from records that include a person x into propositions involving a predication $P(x)$.

(20) $\left(\begin{bmatrix} \text{x:}\mathit{Ind} \\ \text{c:person(x)} \end{bmatrix} \rightarrow \mathit{RecType} \right)$

P is of type *Pred*, that is (*Ind*→*RecType*), the type of functions from individuals to record types. The function, w, which serves as the incremental content (*cf.* Milward and Cooper, 1994) of *who* is given in (21).[7]

(21) $w = \lambda P{:}\mathit{Pred}\ .\ \lambda r{:}\begin{bmatrix} \text{x:}\mathit{Ind} \\ \text{c:person(x)} \end{bmatrix}\ .\ P(r.\text{x})$

Now the updated information state is characterized in (22).

(22) InfState$_1$: T_0 $\boxed{\dot\wedge}$

$$\begin{bmatrix} \text{DGB.Pending} = \begin{bmatrix} \text{sit} = u_1 : \mathit{Sit} \\ \text{sit-type}= \begin{bmatrix} \text{phon : who} \\ \text{cont} = w\text{: } (\mathit{Pred} \rightarrow \mathit{WhPQ}) \end{bmatrix} : \mathit{RecType} \end{bmatrix} : \mathit{RecType} \end{bmatrix}$$

We denote the type computed in (22) by T_1. We take content of the verb *took* to be (23a) (ignoring tense) of type (23b). We represent this content as ‘take′’.

(23) a. $\text{take}' = \lambda y{:}\mathit{Ind}\ .\ \lambda x{:}\mathit{Ind}\ .\ \begin{bmatrix}\text{e:take}(x,y)\end{bmatrix}$ b. (*Ind*→*Pred*)

Thus the incremental content of *who took* can be computed in line with Milward and Cooper (1994) as (24a) which can be expressed with reference to InfState$_1$ as (24b).

[5]This is not a necessary assumption—presumably many utterances are partially planned as their generation starts, hence the occurrence of some filled pauses to buy the speaker planning time.

[6]We assume this visual field is part of the speaker’s DGB, which is again a simplification, since it need not be (quasi)-shared.

[7]Milward and Cooper (1994) offer an explicit procedure that converts such lambda terms to existentially quantified propositions. Their fragment considered only declarative utterances. In the current work we could adapt their procedure to yield existentially quantified *illocutionary* propositions.

(24) a. $\lambda y{:}Ind\ .\ w(\text{take}'(y))$ b. $\lambda y{:}Ind\ .\ \text{InfoState}_1\text{.DGB.Pending.sit-type.cont}(\text{take}'(y))$

We abbreviate (24b) as *wt*. We can compute a type for InfState_2 as in (25).

(25) $\text{InfState}_2 : T_1 \boxed{\wedge}$
$$\left[\text{DGB.Pending} = \begin{bmatrix}\text{sit} = u_2{:}Sit \\ \text{sit-type} = \begin{bmatrix}\text{phon : who took} \\ \text{cont} = wt : (Ind \rightarrow WhPQ)\end{bmatrix}{:}RecType\end{bmatrix}{:}RecType\right]$$

We use T_2 to represent the type computed in (25). J opens the drawer and sees the scissors there. This updates the DGB facts with a fact that the scissors are in the visual field. This, in turn, implies that no one took the scissors, and hence, given the existence of a resolving answer to the question, the original motivation for asking it is eliminated. We can now compute a type for the next information state, InfState_3, as in (26).

(26) $\text{InfState}_3 = T_2 \boxed{\wedge}$ $$\begin{bmatrix}\text{private.agenda} = \left\langle\ \right\rangle{:}\left\langle Type \right\rangle \\ \text{DGB.FACTS} = \left\{ \ldots \begin{bmatrix}\text{x}{:}Ind \\ \text{c:scissors(x)} \\ \text{In(VisSit,x)}\end{bmatrix} \ldots \right\}{:}\left\{Type\right\}\end{bmatrix}$$

4.4. Pending and charts

Information included in the 'Pending'-field of the dialogue gameboard includes a type that represents the agent's view of the ongoing parse as the utterance unfolds. We call this type a *chart-type* because we appeal to a notion of chart parsing for this purpose, though as will become clear our approach is compatible with various other approaches for such representations, for instance Hough's graph-based representation (Hough (2015)) which synthesizes a graph-based Dynamic Syntax view of parsing (Sato (2011)) with the Incremental Unit (IU) framework of Schlangen and Skantze (2011) for incremental processing.

The type of Pending remains *LocProp*, as in (27). The issues that remains is how to explicate T_{chart} in order to understand how incremental content arises.

(27) $$\begin{bmatrix}\text{sit} = s \\ \text{sit-type} = T_{chart}\end{bmatrix}$$

We present here the briefest sketch of chart parsing as it is used in computational linguistics; for a recent textbook introduction to chart parsing see Jurafsky and Martin (2009), Chap. 13, whereas for its implementation in TTR see Cooper (2016). The idea of a chart is that it should store all the hypotheses made during the processing of an utterance which in turn allow us to compute new hypotheses to be added to the chart. Charts can be updated incrementally for each word and they can represent several live possibilities in a single data structure. We will say that a chart is a record and we will use our resources to compute a chart type on the basis of utterance events.

4.5. Charts: a simplified example

Suppose that we have so far heard an utterance of the word *Dudamel*. At this point we will say that the type of the chart is (28)

(28) $$\begin{bmatrix} \mathrm{e}_1 & : & \text{“Dudamel”} \\ \mathrm{e} & : & [\mathrm{e}_1{:}\mathrm{start}(\mathrm{e}_1)]^\frown[\mathrm{e}_1{:}\mathrm{end}(\mathrm{e}_1)] \end{bmatrix}$$

The main event of the chart type (represented by the e-field) breaks the phonological event of type “Dudamel” down into a string of two events, the start and the end of the “Dudamel”-event.[8] Thus (28) records that we have observed an event of the phonological type “Dudamel” and an event consisting of the start of that event followed by the end of that event. Given that we have the resource $\mathrm{Lex}_{\mathrm{PropName}}$(“Dudamel”, *d*) available, we can update (28) to (29):

(29) $$\begin{bmatrix} \mathrm{e}_1 & : & \text{“Dudamel”} \\ \mathrm{e}_2 & : & \mathrm{Lex}_{\mathrm{PropName}}(\text{“Dudamel”}, d)\ \boxed{\wedge}\ [\text{s-event}{:}[\mathrm{e}{=}\mathrm{e}_1{:}\mathit{Phon}]\ ] \\ \mathrm{e} & : & \begin{bmatrix}\mathrm{e}_1{:}\mathrm{start}(\mathrm{e}_1) \\ \mathrm{e}_2{:}\mathrm{start}(\mathrm{e}_2)\end{bmatrix}^\frown\begin{bmatrix}\mathrm{e}_1{:}\mathrm{end}(\mathrm{e}_1) \\ \mathrm{e}_2{:}\mathrm{end}(\mathrm{e}_2)\end{bmatrix} \end{bmatrix}$$

That is, we add the information to the chart that there is an event (labelled ‘e_2’) of the type which is the sign type corresponding to “Dudamel” and that the event which is the speech event referred to in that sign type is the utterance event, labelled by ‘e_1’. Furthermore the duration of the event labelled ‘e_2’ is the same as that labelled ‘e_1’.

The type $\mathrm{Lex}_{\mathrm{PropName}}$(“Dudamel”, *d*) is a subtype of *NP*. Thus the event labelled ‘e_2’ could be the first item in a string that would be appropriate for the function which we have abbreviated as (30a), which has the type (30b).

(30) a. $S \longrightarrow NP\ VP \mid NP'(VP')$ b. $(NP^\frown VP \rightarrow \mathit{Type})$

Cooper (2016) argues for an analogy between non-linguistic event prediction and the prediction that occurs in parsing.[9] So on observing a noun-phrase event one can predict that it might be followed by a verb phrase event thus creating a sentence event. We add a hypothesis event to our chart which takes place at the end of the noun-phrase event as in (31).[10]

[8] These starting and ending events correspond to what are standardly called *vertices* in the chart parsing literature.

[9] Indeed he suggests that this might extend to non-linguistic event prediction among non-humans, e.g., the prediction by a dog playing Fetch that it should run after a stick which is held up.

[10] In terms of the traditional chart parsing terminology this corresponds to an *active edge* involving a *dotted rule*. The fact that the addition of this type to the chart type is triggered by finding something of an appropriate type to be the leftmost element in a string that would be an appropriate argument to the rule corresponds to what is called a *left-corner* parsing strategy.

(31)
$$\left[\begin{array}{lll} e_1 & : & \text{“Dudamel”} \\ e_2 & : & \text{Lex}_{\text{PropName}}(\text{“Dudamel”}, d)\ \boxed{\wedge}\ \left[\text{s-event:}\left[\text{e=e}_1\text{:}\mathit{Phon}\right]\ \right] \\ e_3 & : & \left[\begin{array}{l} \text{rule=}S \longrightarrow \mathit{NP}\ \mathit{VP} \mid \mathit{NP}'(\mathit{VP}')\text{:}(\mathit{NP}^\frown \mathit{VP} \rightarrow \mathit{Type}) \\ \text{fnd=e}_2\text{:}\mathit{Sign} \\ \text{req=}\mathit{VP}\text{:}\mathit{Type} \\ \text{e:required(req,rule)} \end{array}\right] \\ e & : & \left[\begin{array}{l} e_1\text{:start}(e_1) \\ e_2\text{:start}(e_2)\end{array}\right]^\frown \left[\begin{array}{l} e_1\text{:end}(e_1)\\ e_2\text{:end}(e_2) \\ e_3\text{:start}(e_3)^\frown\text{end}(e_3)\end{array}\right] \end{array}\right]$$

In the e_3-field the ‘rule’-field is for a syntactic rule, that is, a function from a string of signs of a given type to a type. The ‘fnd’-field is for a sign or string of signs so far found which match an initial segment of a string of the type required by the rule. The ‘req’-field is the type of the remaining string required to satisfy the rule as expressed in the ‘e’-field. This hypothesis event both starts and ends at the end of the event of the noun-phrase event e_2.

In what follows, we will adopt a simplified version of (31), exemplified in (32). We will omit the ‘e field’.

(32)
$$\left[\begin{array}{l} \text{e1 : “Dudamel”} \\ \text{e2 : Lex}_{NP}(\text{“Dudamel”})\ \boxed{\wedge}\ \left[\text{s-event : }\left[\text{e = e1 : Phon}\right]\right] \\ \text{e3 : } \left[\begin{array}{l} \text{fnd = e2 : Sign} \\ \text{req = } \left[\begin{array}{l} \text{cat = VP : Syncat} \\ \text{cont : (Ind} \rightarrow \text{Prop)} \end{array}\right] \text{: Type} \\ \text{proj = } \left[\begin{array}{l} \text{s-event :fnd.phon }^\frown\text{req.phon} \\ \text{cat = S} \\ \text{cont =req.cont(fnd.cont) : Prop} \end{array}\right] \text{: Type} \end{array}\right] \end{array}\right]$$

5. Incremental Dialogue Processing: principles and examples

With a basic means of representing utterances in progress, we can now formulate certain principles which will serve to help explicate the phenomena discussed in section 2.

5.1. Utterance Projection

The first principle we introduce corresponds to the ‘stop option’ in our utterance protocol (14b)—it says that if one projects that an utterance will continue in a certain way, then one can actually use this prediction to update one’s DGB. This is of course a dangerous principle to apply in an unconstrained fashion, and would ideally be formulated using probabilities about the projection, for instance using the framework of Cooper et al. (2015), though we do not do so here. (33) is an update rule which moves a locutionary proposition from pending to Latest-Move. (r^* represents the previous information state which is required to be of the type labelled ‘preconds’.)

(33) **Utterance Projection**

$$\begin{bmatrix} \text{preconds} = \begin{bmatrix} \text{pending.sit} : \textit{Sign} \\ \text{pending.sit-type.proj} : \textit{Type} \end{bmatrix} \\ \text{effects} = \text{TurnUnderspec} \boxed{\wedge} \begin{bmatrix} \text{LatestMove} = r^* : \textit{LocProp} \end{bmatrix} \end{bmatrix}$$

We exemplify an incremental view of the latest move that is being moved in (33) with a word-by-word evolution of the latest move, analogous to that in section 4.3, but this time for an initial segment of a declarative utterance: *Jo... saw...*

(34) a. $$\begin{bmatrix} \text{sit} = u_1 \\ \text{sit-type} = \begin{bmatrix} \text{phon} : \text{“Jo”} \\ \text{dgb-params} : \begin{bmatrix} \text{j} : \textit{Ind} \\ \text{s0} : \textit{Rec} \end{bmatrix} \\ \text{cont} = \lambda P{:}\textit{Pred} \, . \begin{bmatrix} \text{sit} = s_0 \\ \text{sit-type} = \begin{bmatrix} \text{c1}{:}P(\text{j}) \end{bmatrix} \end{bmatrix} : (\textit{Pred} \rightarrow \textit{Prop}) \end{bmatrix} \end{bmatrix}$$

b. $$\begin{bmatrix} \text{sit} = u_2 \\ \text{sit-type} = \begin{bmatrix} \text{phon} : \text{“Jo saw”} \\ \text{dgb-params} : \begin{bmatrix} \text{j} : \textit{Ind} \\ \text{s0} : \textit{Rec} \end{bmatrix} \\ \text{cont} = \lambda x{:}\textit{Ind} \, . \begin{bmatrix} \text{sit} = \text{s0} \\ \text{sit-type} = \begin{bmatrix} \text{c1:Saw(j},x) \end{bmatrix} \end{bmatrix} : (\textit{Ind} \rightarrow \textit{Prop}) \end{bmatrix} \end{bmatrix}$$

5.2. Forward-Looking Disfluencies

Forward-looking disfluencies are disfluencies where the moment of interruption is followed not by an alteration, but just by a completion of the utterance which is delayed by a filled or unfilled pause (hesitation) or a repetition of a previously uttered part of the utterance (repetitions). As we mentioned with respect to example (4) and in our discussion in section 4.1, we need a means of enabling at any point in the speech stream the emergence of a question about what is still to come in the current utterance. Forward Looking Disfluencies involve the update rule in (35)—given a context where an initial segment of utterance by A has taken place, the next speaker—underspecified between the current one and the addressee—may address the issue of what A intended to say next by providing a co-propositional utterance:

(35) Forward Looking Utterance Rule:

$$\begin{bmatrix} \text{preconds} = \begin{bmatrix} \text{spkr} : \mathit{Ind} \\ \text{addr} : \mathit{Ind} \\ \text{pending.sit-type} : \begin{bmatrix} \text{fnd} : \mathit{Sign} \\ \text{req:}\ \mathit{Sign} \end{bmatrix} \end{bmatrix} \\ \text{effects} = \mathit{TurnUnderspec}\ \boxed{\wedge} \begin{bmatrix} \text{MaxQud} = \\ \begin{bmatrix} \text{q} = \lambda x{:}\mathit{Ind}\ .\ \text{MeanNextUtt}(r^{*}.\text{spkr}, r^{*}.\text{fnd}, x) \\ \text{fec} = \left\{\right\} \end{bmatrix} : \mathit{InfoStruc} \\ \text{LatestMove} : \mathit{LocProp} \\ \text{c2: Copropositional}(\text{LatestMove}^{content}, \text{MaxQud}) \end{bmatrix} \end{bmatrix}$$

A consequence of (35), is that it offers the potential to explain cases like (36). In the aftermath of a filled pause an issue along the lines of the one we have *posited* as the *effect* of the conversational rule (35) actually gets uttered:

(36) a. Carol 133 Well it's (pause) it's (pause) er (pause) what's his name? Bernard Matthews' turkey roast. (BNC, KBJ)
b. They're pretty ... um, how can I describe the Finns? They're quite an unusual crowd actually.
`http://www.guardian.co.uk/sport/2010/sep/10/small-talk-steve-backley-interview`

On our account such utterances are licensed because these questions are co-propositional with the issue 'what did A mean to say after u0?'. This suggests that a different range of such questions will occur depending on the identity of (the syntactic/semantic type of) u0. This expectation is met, as discussed in Tian et al. (2016), who also discuss cross-linguistic variation with SAQs in English, Chinese, and Japanese.

5.3. Prediction and Clarification for incomplete utterances

We return now to (2a,b), repeated here as (37):

(37) a. A(i): John . . . Oh never mind. B(ii): What about John? A: He's a lovely chap but a bit disconnected. / # burnt himself while cooking last night.
b. A(i): John . . . Oh never mind. B(ii): John what? A: burnt himself while cooking last night. / # He'ss a lovely chap but a bit disconnected.

Whether (2a) or (2b) arise depends on whether one uses utterance projection or the forward looking utterance rule. For the former, as we showed in (34), an initial referential NP when prediction is applied results in (roughly) the projected content in (38). Thus, given the conversational rule *QSPEC* (the rule (9) above), B's follow up questions are justified as seeking elaboration of the existentially quantified proposition $\exists P$ IllocRel$(spkr, P(j))$:

(38) LatestMove = $\left[\begin{array}{l}\text{sit} = u_1 \\ \text{sit-type}= \left[\begin{array}{l}\text{phon : "John"} \\ \text{dgb-params : } \left[\begin{array}{l}\text{j : } \mathit{Ind} \\ \text{s0 : } \mathit{Rec}\end{array}\right] \\ \text{cont} = \lambda P{:}\mathit{Pred}\ .\ \left[\begin{array}{l}\text{sit = s0} \\ \text{sit-type} = \left[\text{c1:}P(\text{j})\right]\end{array}\right] : (\mathit{Pred}{\rightarrow}\mathit{Prop})\end{array}\right]\end{array}\right]$

As for (2b), this follows by applying the forward looking utterance rule, where the addressee takes over.

5.4. Sluicing, incrementally

We assume, following Cooper (2013a) that a QNP such as 'someone' has a content of the form (39), where *q-params* constitute descriptive content that, in contrast to the dgb-params, does not require instantiation.

(39) $\left[\begin{array}{l}\text{q-params: } \left[\begin{array}{l}\text{restr = person: Ppty} \\ \text{witness : } \exists\text{(restr)}\end{array}\right] \\ \text{P : Ppty} \\ \text{cont = } \left[\begin{array}{l}\text{scope = P :Ppty} \\ \text{c1 = witness : } \exists\text{(restr,scope)}\end{array}\right]\text{: Rtype}\end{array}\right]$

We assume a constructional specification for a sluice as in (40), deriving from Ginzburg (2012). A sluice denotes a question (i.e., a function from records into propositions) whose domain is the type denoted by the *wh*-phrase and whose range is that given by MaxQUD's proposition where the *wh*-phrase's variable is substituted for that associated with the antecedent:

(40) sluice-int-cl.cont = (whP.rest)MaxQUD.prop[antecedent.x $\mapsto$whP.x]

The sluice is triggered by utterance prediction that LatestMove is *A asserts that Someone P'ed*. This gives rise to QUD update, via Assertion QUD-incrementation with (41a) as maximal element of QUD and the antecedent for a sluice, as in (41b), which is predicted to mean (41c) immediately after it is uttered:

(41) a. $?\exists x, P$[Person(x) $\wedge$ P(x)]
b. A: Someone ... B: Who?
c. 'Who is that person (that has some as yet uninstantiated property)?'

6. Conclusions and further Work

In this paper we provide data related to the potential for clarification, repair, and sluicing in mid-utterance. This data shows that the "competence grammar" must be formulated in a way that enables incremental (minimally word by word and even mid-word) semantic composition to be effected. In particular, this data constitutes an argument for incremental access to the contextual repository QUD. This approach has parallels to Dynamic Syntax (Kempson et al., 2001), and particularly recent dialogue-friendly versions (Purver et al., 2011; Kempson et al., 2016), where the central idea is online, incremental construction of meaning representations. However, the incremental account presented here not only allows the representation of utterances, but the internal state of a dialogue agent, including background beliefs and the events in the situated context, to be updated online for entire interactions. In a more detailed presentation we will present a small grammar/context fragment. In future work we hope to investigate experimentally the processing of data of the kind presented here.

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Control, logophorocity, and harmonic modality in Gengbe desire reports[1]

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Abstract. With a special focus on jussive clauses, we present and account for a puzzling interaction between mood choice, embedding verb choice, and antecedent choice for logophoric subjects in attitude reports in Gengbe (a Niger-Congo language closely related to Ewe, spoken in southern Togo and Benin). The account draws on the property theory of control (Chierchia, 1984; Dowty, 1985), the property theory of imperatives (Portner, 2004), and the view that logophors abstract to yield derived properties (Pearson, 2015). Insofar as Gengbe jussive clauses are similar in distribution and function to Romance subjunctive clauses, a primary theoretical contribution of the paper is in showing that Portner's property analysis of imperatives can be fruitfully extended to subjunctive clauses, thereby achieving a theoretical unification of sentence mood and verbal mood. We also a sketch a variant of the account couched in Kratzer's (2013) decompositional approach to embedding, whereby jussive clauses in Gengbe desire reports instantiate harmonic modality.

Keywords: attitude reports, control, jussives, logophors, modality, mood

1. Introduction

The grammatical category MOOD is typically taken to subsume at least two subtypes. Following Portner's (2009) terminology, SENTENCE MOOD has to do with clause type oppositions like those illustrated in (1), and VERBAL MOOD prototypically has to do with selected verbal forms such as the well studied Romance indicative/subjunctive opposition illustrated with the Spanish data in (2).

(1) SENTENCE MOOD
a. John left. DECLARATIVE
b. Did John leave? INTERROGATIVE
c. Leave! IMPERATIVE

(2) VERBAL MOOD
a. Juan cree que Pedro **es** feliz. INDICATIVE
'Juan believes that Pedro is.IND happy.'
b. Juan quiere que Pedro **sea** feliz. SUBJUNCTIVE
Lit.: 'Juan wants that Pedro be.SBJV happy.'

The context for this paper is set by the theory of sentence mood advanced by Portner (2004) and further elaborated by Portner (2007); Zanuttini et al. (2012). Following the widely influential tradition of Stalnaker (1978), Portner takes the position that declarative clauses denote propo-

[1]We would like to thank our linguistic consultant Gabriel Mawusi for his tireless efforts in producing and commenting on the Gengbe sentences reported here and Samuel Obeng for supporting this research. We would also like to thank audiences at Indiana University as well as at *SuB* 21 for their helpful feedback on the content of the paper.

sitions and that making an assertion amounts to adding a proposition to the Common Ground, which can be modeled as a set of propositions. In a similar vein, Portner follows Hamblin (1973); Karttunen (1977) in analyzing interrogative clauses as denoting sets of propositions, and follows Ginzburg (1995); Roberts (1996) in modeling question speech acts as adding a set of propositions to the Question Set, which can be modeled as a set of sets of propositions. Finally, Portner's main contribution is in building on a proposal due to Hausser (1980) and analyzing imperative clauses as denoting properties of individuals. For Portner, directive force involves adding a property to the addressee's To-Do List, which is a set of properties that the participants in the conversation mutually assume that the addressee will try to make true of herself.

In this context, the narrow goal of this paper is to argue that JUSSIVE clauses in Gengbe[2] are also fruitfully analyzed as denoting properties of individuals, as evidenced primarily by how they interact with antecedent choice for logophoric pronouns in embedded contexts. We define jussive clauses in Gengbe as clauses that contain the preverbal marker *nɛ̃́*, a marker which we correspondingly call the jussive marker and gloss as JUSS.[3] Some representative examples illustrating the distribution and interpretation of jussive clauses in Gengbe are given in the bracketed constituents in (3)–(6).

(3) [Kòfí **nɛ̃́** ɖù nṹ].
Kofi JUSS eat thing
'Kofi should eat.' / 'I want Kofi to eat.'

(4) Kòfí dóòṹsɛ̃́ɛ̃̀ Àkú [bé **nɛ̃́** ɖù nṹ].
Kofi encourage Aku COMP JUSS eat thing
'Kofi encouraged Aku to eat.'

(5) Ámã́ **dʒí** [bé **Àkú nɛ̃́** ɖù nṹ].
Ama want COMP Aku JUSS eat thing
'Ama wants Aku to eat.'

(6) Ámã́ **kã́ɖóédʒí** [bé **Àkú nɛ̃́** ɖù nṹ].
Ama believe COMP Aku JUSS eat thing
'Ama believes that Aku should eat.'

Assuming for the sake of argument that we are right in analyzing jussive clauses as property-denoting, what is the theoretical significance of this conclusion? If jussive clauses distributed and functioned just like imperative clauses, then our conclusion would simply count as further supporting evidence for Portner's theory of clause types, but not a novel theoretical proposal.

[2] Gengbe (also known as *Gen* or *Mina*) is a Niger-Congo language closely related to Ewe and spoken in southern Togo and Benin. According to Ethnologue, it has 278,900 speakers worldwide. All of the data reported here were collected at Indiana University by the authors in consultation with Gabriel Mawusi, a middle-aged male native Gengbe speaker from Batonou, Togo.

[3] A full list of the abbreviations we use in glosses is as follows: ACC = accusative, COMP = complementizer, EXH = exhortative, INDIC = indicative, JUSS = jussive, IMP = imperative, LOG = logophor, PL = plural, POT = potential, PRM = promissive, SBJV = subjunctive, 1/3SG = 1st/3rd-person singular

But in fact, jussive clauses do not function like imperative clauses: of the examples in (3)–(6), the only one we are aware of that could be translated using an imperative clause is (4), and even this is possible only in languages like Korean that allow embedded imperatives (see e.g. Zanuttini et al. 2012). Instead, jussive clauses behave more like Romance subjunctive clauses, useable to express optative-like meaning in unembedded contexts (3), and found in complements to directive (4) and desiderative (5) predicates. The only non-subjunctive-like behavior is witnessed in (6), where the jussive marker is embedded under 'believe' and expresses a deontic semantics; in Romance, by contrast, mood choice under 'believe' is subject to inter- and intra-linguistic variation, but the subjunctive in this environment in those cases where it is possible is not associated with a deontic semantics. (See e.g. Giorgi and Pianesi 1997 for a survey of mood choice in Romance.)

Given that the distribution and interpretation of Gengbe jussive clauses is not absolutely identical to the distribution and interpretation of Romance subjunctive clauses, we do not mean to suggest that they should have identical analyses. But we do take our property analysis of Gengbe jussive clauses to be highly suggestive of the more general utility of taking Portner's type-theoretic approach to sentence mood and extending it to verbal mood as well, thereby contributing to a theoretical unification of the two major mood subtypes. Making this case constitutes a broader theoretical aim of this paper, and in the course of carrying out this broader aim, we will suggest below that Romance subjunctive clauses are also fruitfully analyzed as property-denoting.

The organization of the rest of this paper is as follows. In section 2, we lay out our core data and puzzles. In section 3, we show that the data can be accounted for via three key proposals: (1) logophors are obligatorily bound by an attitude predicate (following Pearson 2015), (2) jussive clauses denote properties, and (3) Gengbe 'want' selects for a property whereas Gengbe 'believe' is flexible in being able to select for either a property or a proposition. In section 4, we unpack these proposals, grounding them in ideas found in previous literature and advancing independent Gengbe-internal and cross-linguistic support for them. In section 5 we compare two analytical strategies for implementing the property analysis of jussive clauses, one whereby the jussive marker is an individual abstractor *à la* Zanuttini et al. (2012) and one whereby the jussive marker is an individual-relative priority modal that harmonizes with the embedding predicate in embedded contexts *à la* Kratzer (2013). Finally, section 6 concludes.

2. Core data and puzzles

The first observation we make is that Gengbe has a logophoric pronoun *jè* which at first glance seems to behave like an ordinary logophor in the sense of Clements (1975): it must be embedded under a speech or attitude predicate, and it is obligatorily co-referential with the subject of that predicate. In (7), multiple embedding gives rise to the expected ambiguity whereby *jè* can be co-referential either with *Ámā̃́* (the subject of the immediately higher clause) or with *Kòfí* (the matrix subject).

(7) **Kòfí**$_1$ bé **Ámã́**$_2$ kã́ɖóédʒí [bé **jè**$_{1/2/*3}$ ɖù nű].
Kofi say Ama believe COMP LOG eat thing
'Kofi said Ama believes that he/she (= Kofi/Ama) ate.'

With this in mind, the core puzzle we want to solve is the observation that when *jè* is embedded under *dʒí* 'want', the availability of different antecedents interacts with mood choice. As seen in (8), when *dʒí* embeds the mood marker *lá* (which we analyze as a potential marker, following Essegbey's 2008 treatment of Ewe *a*), the logophor obligatorily co-refers with the subject of the immediately higher clause (the hallmark of obligatory control in the sense of Landau 2000), but as seen in (9), when *dʒí* embeds the jussive marker *nɛ̃́*, the logophor is obviative with respect to the subject of the immediately higher clause and instead obligatorily co-refers with the subject of a higher embedding clause.[4]

(8) (Àkú$_1$ bé Kòfí$_2$ bé) **Ámã́**$_3$ **dʒí** [bé **jè**$_{(*1/*2/)3/*4}$ **lá** ɖù nű].
Aku say Kofi say Ama want COMP LOG POT eat thing
'(Aku said that Kofi said that) Ama wants to eat.' (control)

(9) (**Àkú**$_1$ bé) **Kòfí**$_2$ bé Ámã́$_3$ **dʒí** [bé **jè**$_{(1/)2/*3/*4}$ **nɛ̃́** ɖù nű].
Aku say Kofi say Ama want COMP LOG JUSS eat thing
'(Aku said that) Kofi said that Ama wants him (= (Aku/)Kofi) to eat.' (obviation)

The pattern in (8)–(9) is not unique to *dʒí* 'want' but is found also with other attitude predicates expressing desiderative, intentional or promissive meaning such as *wɔ̀súsú* 'intend', *dʒèàgbàgbá* 'try', *lɔ̃̀* 'agree', and *fjɛ̃̀dʒɔ̀gbè* 'pledge'.

While we take the mood–coreference interaction in (8)–(9) to be the core explanandum of this paper, there are two subsidiary puzzles that we take to be important clues in understanding (8)–(9), and we want to make sure that our analysis accounts for these subsidiary puzzles as well. The first subsidiary puzzle has to do with what happens when the complement to *dʒí* 'want' has a non-logophoric, full-NP subject. In this situation, what we see is that the mood marker *lá* is simply unacceptable (10) and *nɛ̃́* has to be used instead (11).

(10) *Kòfí bé Ámã́ **dʒí** [bé **Àkú lá** ɖù nű].
Kofi say Ama want COMP Aku POT eat thing
Intended: 'Kofi said Ama wants Aku to eat.'

[4]Further strengthening the analytical connection to control and obviation phenomena, it bears noting that logophoric *objects* behave differently, admitting free choice of antecedent in the context of jussive marking (and potential marking would be ungrammatical here because of the full-NP subject; cf. (10)):

(i) **Kòfí**$_1$ bé **Ámã́**$_2$ **dʒí** [bé Àkú$_3$ **nɛ̃́** kpɔ́ **jè**$_{1/2/*3}$].
Kofi say Ama want COMP Ama JUSS see LOG
'Kofi said Ama wants Aku to see him/her (= Kofi/Ama).'

This subject/object asymmetry is likely connected to the fact that control is a subject-oriented phenomenon: generally only subject positions can be controlled. Unfortunately, though, this subject/object asymmetry is not something that we will be able to account for in this paper.

(11) Kòfí bé Ámã́ **dʒí** [bé **Àkú nɛ̃́** ɖù nṹ].
Kofi say Ama want COMP Aku JUSS eat thing
'Kofi said Ama wants Aku to eat.'

The second subsidiary puzzle has to do with what happens when *dʒí* 'want' is replaced with *kã́ɖóédʒí* 'believe'. As we already saw in (7) above, *kã́ɖóédʒí* 'believe' can combine with complements that are not overtly marked for mood. But overt mood marking is also possible. Considering first full-NP subjects in the complement clause, we see that both *lá* and *nɛ̃́* are acceptable and give rise to a difference in meaning suggested by the supplied free translations: *lá* gives rise to a future-oriented meaning (12) whereas *nɛ̃́* gives rise to a deontic meaning (13).

(12) Kòfí bé Ámã́ **kã́ɖóédʒí** [bé **Àkú lá** ɖù nṹ].
Kofi say Ama believe COMP Aku POT eat thing
'Kofi said Ama believes that Aku will eat.'

(13) Kòfí bé Ámã́ **kã́ɖóédʒí** [bé **Àkú nɛ̃́** ɖù nṹ].
Kofi say Ama believe COMP Aku JUSS eat thing
'Kofi said Ama believes that Aku should eat.'

Finally, when the full-NPs in (12)–(13) are replaced by the logophor, yet another interesting pattern emerges: when the mood marker *lá* is used, the logophor can take either of the higher subjects as its antecedent, just as in (7) where there is no overt mood marking. This is illustrated in (14). But when the mood marker *nɛ̃́* is used, we see the return of the *dʒí* 'want'-like behavior witnessed in (9) above: only the more distant subject is available as an antecedent. This is illustrated in (15).

(14) **Kòfí**$_1$ bé **Ámã́**$_2$ **kã́ɖóédʒí** [bé **jè**$_{1/2}$ **lá** ɖù nṹ].
Kofi say Ama believe COMP LOG POT eat thing
'Kofi said Ama believes that he/she (= Kofi/Ama) will eat.'

(15) **Kòfí**$_1$ bé Ámã́$_2$ **kã́ɖóédʒí** [bé **jè**$_{1/*2}$ **nɛ̃́** ɖù nṹ].
Kofi say Ama believe COMP LOG JUSS eat thing
'Kofi said Ama believes that he (= Kofi) should eat.'

The behavior seen in (12)–(15) is not unique to *kã́ɖóédʒí* 'believe'; it is also borne out for other predicates including *ɲã́* 'know', *gblɔ̃̀* 'say', and *kúùdrĩ̌ĩ́* 'dream'.

3. The proposed solution in three stipulations

The goal of this section is to show that all of the puzzles associated with the data from the previous section can be accounted for with just three rather mundane stipulations. (We call them stipulations for now so as to focus on how they account for the data rather than on how they might be independently justified; the task of independently justifying the stipulations is taken up in section 4.) We will first describe the three stipulations, and then show how they make sense of the data.

The perspective from which we approach the puzzles begins with the recognition that these puzzles reduce to three kinds of asymmetries: logophoric subjects pattern unlike full-NP subjects, the jussive marker patterns unlike the potential marker, and 'want' patterns unlike 'believe'. One way or another, then, the grammar of Gengbe will need to draw a distinction in each of these three areas. Each of the three stipulations we advance targets one of these asymmetries, putting the bulk of the explanatory burden on the semantic type system. Portner (2004) establishes the utility of exploiting the type system in understanding mood contrasts, which we take to provide a kind of *a priori* justification for going down this path.

The first stipulation identifies a contrast between logophors and ordinary full-NPs or pronouns: namely, what is special about a logophor is that it has to be bound by an attitude predicate (following Pearson 2015, who builds on Heim 2002; von Stechow 2002, 2003). So, if a structure contains a logophoric pronoun, that pronoun can be bound by an attitude predicate in the immediately higher clause, as in (16a), or by an attitude predicate in some higher clause, as in (16b), but if it is not bound by any attitude predicate at all, as in (16c), then the structure is ungrammatical.

(16) **Stipulation #1:** A logophor has to be bound by an attitude predicate:
a. Kofi say [Ama **believe** [λx. [**LOG**$_x$ eat]]] OK
b. Kofi **say** [λx. [Ama believe [**LOG**$_x$ eat]]] OK
c. Kofi say [Ama believe [LOG$_x$ eat]] ungrammatical

The second stipulation identifies a contrast between jussive and potential marking: in particular, the Gengbe jussive marker *nɛ̃́* contributes an individual argument whereas the potential marker *lá* does not. Assuming for concreteness that a Gengbe clause with no mood marking has a type $\langle st \rangle$ denotation, this means that a jussive-marked clause will be type $\langle e, st \rangle$, as in (17a). By contrast, the potential marker has no interesting type-theoretic effect, as in (17b).

(17) **Stipulation #2:** *nɛ̃́* 'JUSS' contributes an individual argument but *lá* 'POT' does not:
a. [Kofi eat]$_{\langle st \rangle}$ $\rightarrow$ [λx . Kofi JUSS eat]$_{\langle e,st \rangle}$
b. [Kofi eat]$_{\langle st \rangle}$ $\rightarrow$ [Kofi POT eat]$_{\langle st \rangle}$

Finally, the third stipulation identifies a contrast between between *dʒí* 'want' and *kɑ̃́ɖóédʒí* 'believe': *dʒí* 'want' is type-theoretically rigid in only being able to combine with a property-denoting complement, whereas *kɑ̃́ɖóédʒí* 'believe' is type-theoretically flexible in being able to combine either with a property-denoting complement or a proposition-denoting complement. This is schematized in (18).

(18) **Stipulation #3:** *dʒí* 'want' can only combine with a property whereas *kɑ̃́ɖóédʒí* 'believe' can combine with either a proposition or a property:
a. $[\![$dʒí$]\!]$ = $\lambda P_{\langle e,st \rangle} \lambda x \lambda w. \forall w' \in$ BEST$_{desire}$(DOX(x,w)): P(x)(w') $\langle \langle e, st \rangle, \langle e, st \rangle \rangle$
b. $[\![$kɑ̃́ɖóédʒí$]\!]$ = $\lambda p_{\langle st \rangle} \lambda x \lambda w. \forall w' \in$ DOX(x,w): p(w') $\langle st, \langle e, st \rangle \rangle$
b′. $[\![$kɑ̃́ɖóédʒí′$]\!]$ = $\lambda P_{\langle e,st \rangle} \lambda x \lambda w. [\![$kɑ̃́ɖóédʒí$]\!]$(P(x))(x)(w) $\langle \langle e, st \rangle, \langle e, st \rangle \rangle$
= $\lambda P_{\langle e,st \rangle} \lambda x \lambda w. \forall w' \in$ DOX(x,w): P(x)(w')

The fine-grained semantics of desire predicates will not be relevant for anything that follows but we assume for concreteness as in (18a) that 'want' involves a bouletic (BEST_{desire}-based) ordering source over the attitude holder's doxastic alternatives, essentially following von Fintel (1999) (though cf. also Heim 1992; Giannakidou 1999 and many others for variations on this theme). Von Fintel's semantics for 'want' is modified here so that the first argument of 'want' is a property whose unsaturated individual argument gets identified with the attitude holder (see Chierchia 1984, 1990; Dowty 1985, and more recently Stephenson 2010; Pearson 2016 for more sophisticated variants of this basic idea). As for 'believe', we adopt for concreteness the standard Hintikkan view that it effects universal quantification over the attitude holder's doxastic alternatives; crucially for us, it comes in both a $\langle st, \langle e, st \rangle\rangle$ variant, as in (18b), as well as a $\langle\langle e, st\rangle, \langle e, st\rangle\rangle$ variant, as in (18b′), the latter of which can be derived from the former as a type shift. Just like we did for 'want' in (18a), the type-shifted variant of 'believe' in (18b′) is set up in such a way that the unsaturated position associated with the property argument gets identified with the attitude holder.

With these three stipulations in place, all of the puzzling asymmetries laid out in the previous section immediately follow. Consider first what we called the core puzzle, i.e., the interaction seen in desire reports between mood marker choice and antecedent choice for logophors, repeated schematically in (19)–(20).

(19) Kofi$_1$ say [Ama$_2$ want [LOG$_{*1/2}$ POT eat]] want+LOG+POT → CTRL

(20) Kofi$_1$ say [Ama$_2$ want [LOG$_{1/*2}$ JUSS eat]] want+LOG+JUSS → OBV.

The unavailability of a long-distance antecedent construal for the logophor in (19) follows from the fact that only the local antecedent construal results in 'want' combining with a type $\langle e, st\rangle$ complement, which is the only kind of complement it accepts. As schematized in (21), local binding of the logophor by 'want' renders the relevant complement a type $\langle e, st\rangle$ expression (21a), whereas long-distance binding of the logophor by 'say' preserves the type $\langle st\rangle$ status of the complement to 'want' and therefore results in type-mismatch-induced uninterpretability (21b).

(21) want+LOG+POT induces control:
a. Kofi say Ama [want$_{\langle\langle e,st\rangle,\langle e,st\rangle\rangle}$ [λx. LOG$_x$ POT eat]$_{\langle e,st\rangle}$] ← OK
b. Kofi say [λx.Ama want$_{\langle\langle e,st\rangle,\langle e,st\rangle\rangle}$ [LOG$_x$ POT eat]$_{\langle st\rangle}$] ← *

In (20), by contrast, when a jussive-marked clause is used, the opposite holds. Local binding of the logophor by 'want' conspires with individual-argument-introducing JUSS to yield a type $\langle e, \langle e, st\rangle\rangle$ complement for 'want', and this yields a type mismatch. But long-distance binding of the logophor by 'say' ensures that the complement to 'want' is type $\langle e, st\rangle$ (achieved via the JUSS-induced individual argument added onto an underlyingly type $\langle st\rangle$ clause), so the structure is interpretable. (We assume here and in what follows that 'say' is like 'believe' in being able to accept both $\langle st\rangle$ and $\langle e, st\rangle$ complements.)

(22) want+LOG+JUSS induces obviation:
a. Kofi say Ama [want$_{\langle\langle e,st\rangle,\langle e,st\rangle\rangle}$ [$\lambda x\lambda y$. LOG$_x$ JUSS eat]$_{\langle e,\langle e,st\rangle\rangle}$] ← *
b. Kofi say [λx.Ama want$_{\langle\langle e,st\rangle,\langle e,st\rangle\rangle}$ [λy. LOG$_x$ JUSS eat]$_{\langle e,st\rangle}$] ← OK

The two subsidiary puzzles also fall into place. The first of the two subsidiary puzzles was that when 'want' embeds a full-NP subject, the embedded clause cannot be potential-marked and instead must be jussive-marked, as repeated schematically in (23)–(24).

(23) *Kofi say [Ama want [Aku POT eat]] want+full-NP+POT → *

(24) Kofi say [Ama want [Aku JUSS eat]] want+full-NP+JUSS → OK

The facts in (23)–(24) now similarly follow from type-theoretic principles, as schematized in (25). With no logophoric binding at stake, the potential marker results in a type $\langle st\rangle$ denotation, which 'want' cannot handle, whereas the jussive marker yields a type $\langle e,st\rangle$ complement, appropriate for 'want'.

(25) a. Kofi say [Ama want$_{\langle\langle e,st\rangle,\langle e,st\rangle\rangle}$ [Aku POT eat]$_{\langle st\rangle}$] ← *
b. Kofi say [Ama want$_{\langle\langle e,st\rangle,\langle e,st\rangle\rangle}$ [λx.Aku JUSS eat]$_{\langle e,st\rangle}$] ← OK

Finally, the second of the two subsidiary puzzles was the observation that when 'want' is replaced by 'believe', all of the restrictions go away, except that a logophor in a jussive-marked clause still resists local binding just like it does for 'want'. This is repeated schematically in (26)–(29).

(26) Kofi say [Ama believe [Aku POT eat]] believe+full-NP+POT → OK

(27) Kofi say [Ama believe [Aku JUSS eat]] believe+full-NP+JUSS → OK

(28) Kofi$_1$ say [Ama$_2$ believe [LOG$_{1/2}$ POT eat]] believe+LOG+POT → AMBIG.

(29) Kofi$_1$ say [Ama$_2$ believe [LOG$_{1/*2}$ JUSS eat]] believe+LOG+JUSS → OBV.

Turning first to (26)–(27), type-theoretic flexibility for 'believe' ensures that both kinds of mood markers will be acceptable when no logophors are present. As schematized in (30), potential-marking yields a type $\langle st\rangle$ complement and jussive-marking yields a type $\langle e,st\rangle$ complement.

(30) Type flexibility for 'believe' renders believe+full-NP+POT / believe+full-NP+JUSS both OK:
a. Kofi say [Ama believe$_{\langle\langle st\rangle,\langle e,st\rangle\rangle}$ [Aku POT eat]$_{\langle st\rangle}$] ← OK
b. Kofi say [Ama believe$_{\langle\langle e,st\rangle,\langle e,st\rangle\rangle}$ [λx. Aku JUSS eat]$_{\langle e,st\rangle}$] ← OK

Turning next to (28), here again type-theoretic flexibility for 'believe' ensures the availability of both binding options: as schematized in (31), long-distance binding yields a type $\langle st\rangle$ complement and local binding yields a type $\langle e,st\rangle$ complement.

(31) Type flexibility also enables both binding options for believe+LOG+POT:
a. Kofi say [λx. Ama believe$_{\langle\langle st\rangle,\langle e,st\rangle\rangle}$ [LOG$_x$ POT eat]$_{\langle st\rangle}$] ← OK
b. Kofi say [Ama believe$_{\langle\langle e,st\rangle,\langle e,st\rangle\rangle}$ [λx. LOG$_x$ POT eat]$_{\langle e,st\rangle}$] ← OK

Finally, we turn to (29): why does a jussive-marked clause force long-distance binding of the logophor? The answer is that local binding conspires with jussive marking to yield a type $\langle e,\langle e,st\rangle\rangle$ complement, which 'believe' (just like 'want') cannot tolerate. This is schematized in (32).

(32) But even with type flexibility, believe+LOG+JUSS induces obviation:
a. Kofi say [Ama believe$_{\langle\langle st\rangle,\langle e,st\rangle\rangle/\langle\langle e,st\rangle,\langle e,st\rangle\rangle}$ [$\lambda x \lambda y$. LOG$_x$ JUSS eat]$_{\langle e,\langle e,st\rangle\rangle}$] ← *
b. Kofi say [λx. Ama believe$_{\langle\langle e,st\rangle,\langle e,st\rangle\rangle}$ [λy. LOG$_x$ JUSS eat]$_{\langle e,st\rangle}$] ← OK

In short, we have now seen that all of the data in section 2 follow from the three stipulations in (16)–(18) about the expressions involved in the relevant structures. The task now before us is to independently justify these stipulations.

4. Revisiting the three stipulations

4.1. A logophor has to be bound by an attitude predicate

The first of our three stipulations, namely that a logophor has to be bound by an attitude, is not new to us and so we will not dwell on it extensively here. Pearson (2015) defends this view, attributing it to earlier work by Heim (2002); von Stechow (2002, 2003). It is a rather straightforward way of deriving the generalization that logophors can appear only in attitudinal contexts. Insofar as these authors were concerned with facts quite different from those at issue here, we take their work as providing independent justification for this proposal.

We are not committed to any particular way of encoding this proposal into the grammar, but for concreteness, we can adopt Pearson's (2015) approach, following Heim (2002); von Stechow (2002, 2003), in hypothesizing that logophors enter the derivation with an uninterpretable feature [log]. This feature must be checked via binding by an operator that also bears the [log] feature. Attitude predicates bear the [log] feature, and an attitude predicate can pass this feature to an individual abstractor in the left periphery of its CP complement. Returning to our three crucial cases in (33), (33a–b) are both grammatical because the [log] feature on the logophor is checked by its binder, whereas (33c) crashes because the [log] feature on the logophor is not checked.

(33) a. Kofi say [Ama **believe**$_{[log]}$ [λx$_{[log]}$. [**LOG**$_{x[log]}$ eat]]] OK
b. Kofi **say**$_{[log]}$ [λx$_{[log]}$. [Ama believe [**LOG**$_{x[log]}$ eat]]] OK
c. Kofi say [Ama believe [LOG$_{x[log]}$ eat]] ungrammatical

4.2. *Nɛ̃́* ‘JUSS’ contributes an individual argument whereas *lá* ‘POT’ does not

We turn our attention now to the proposal that the jussive marker *nɛ̃́* contributes an individual argument whereas the potential marker *lá* ‘POT’ does not. The first thing to note is that in unembedded contexts, *lá* is typically used to express future possibility (34) (cf. Essegbey 2008), whereas *nɛ̃́*, as already seen in the introduction, is used to indicate a speaker-oriented desire or priority (35).

(34) Kòfí **lá** ɖù nṹ.
Kofi POT eat thing
‘Kofi will/might eat.’

(35) Kòfí **nɛ̃́** ɖù nṹ.
Kofi JUSS eat thing
‘Kofi should eat.’ / ‘I want Kofi to eat.’

We also note that Ameka (2008), investigating the cognate Ewe jussive particle *né*, provides some examples suggesting that this marker sometimes has an optative flavor, and we have confirmed that the same is true for Gengbe, as in (36).

(36) gbɔ̀gbɔ̀ vɔ̃́-wó **nɛ̃́** dògó.
spirit bad-PL JUSS exit
‘Let evil spirits come out.’ (Gengbe version of Ameka’s 2008:152 Ewe example)

We take this priority-oriented, optative-like status to be highly suggestive that *nɛ̃́* is in the same family of morphemes identified by Zanuttini et al. (2012) as jussives, which for them include imperatives (37), promissives (38), exhortatives (39), and (possibly) optatives (40) — though their focus is on the former three and they do not commit to a particular analysis of optatives. The data in (37)–(40) are all taken from their paper.

(37) Cemsim-ul sa-**la**.
lunch-ACC buy-IMP
‘Buy lunch!’ (Korean imperative, Zanuttini et al. 2012:1234)

(38) Cemsim-ul sa-**ma**.
lunch-ACC buy-PRM
‘I will buy lunch.’ (Korean promissive, Zanuttini et al. 2012:1234)

(39) Cemsim-ul sa-**ca**
lunch-ACC buy-EXH
‘Let’s buy lunch.’ (Korean exhortative, Zanuttini et al. 2012:1234)

(40) k^{h}a:y
eat-IMP.3SG
‘Let him eat.’ (Bhojpuri optative, Zanuttini et al. 2012:1252)

Zanuttini et al. (2012) propose that jussives are individual abstractors that, when standing in a sufficiently local syntactic configuration with the subject, bind that subject and impose a person restriction on it, as schematized in (41). What distinguishes different kinds of jussives is the value of the person restriction: second-person for imperatives, first-person (exclusive) for promissives, and first-person (inclusive) for exhortatives. The person value also determines whose To-Do List the property gets added to when the utterance is successful in its illocutionary aim: the addressee's for imperatives, the speaker's for promissives, and both the speaker's and the addressee's for exhortatives.

(41) For any phrase XP,
$[\![\text{JUSS}[\text{person: } v]_k \text{ XP}]\!]^{g,c} = [\lambda x : x = [\![[\text{person: } v]_k]\!]^{g,c} \,.\, [\![\text{XP}]\!]^{g[k\rightarrow x],c}\,]$
(Zanuttini et al. 2012:1265)

In a footnote (p. 1252, note 30), Zanuttini et al. mention a suggestion by Patrick Grosz for fitting optatives into this setup, namely by 'relaxing the restriction that it should be possible for the addressee to bring about the situation described', so that the property associated with the optative is added to the addressee's To-Do List and 'the addressee is committed to the judgment that a world in which [the content associated with the optative holds] is preferable to one in which [it] doesn't, even though we know that the addressee cannot bring the world to this preferable state'. While conceivable, this suggestion seems to us to fit awkwardly with the fact that on this view, imperatives, promissives and exhortatives all receive an analysis whereby the person restriction they impose matches the participant associated with the targeted To-Do List, whereas optatives target the addressee's To-Do List despite generally being compatible with subjects of any person value.

In light of this, what we would like to suggest as an alternative is that optatives induce individual abstraction without any person restriction. The status of the utterance as a property has the discourse-theoretic effect of endowing it with a 'world-to-word' direction of fit (in the sense of Searle 1969), but the lack of person restriction has the consequence that it is not directed at any particular individual's To-Do List. This has the pragmatic effect of expressing a wish without imposing on anyone an obligation for its fulfillment. Applied to the Gengbe jussive marker *nɛ́*, this analysis amounts to (42).[5] (Cf. Sæbø 2009 for a strikingly similar approach to English *have*, though we will resist the urge to speculate here on whether an analytical connection between jussives/optatives and *have* is a good thing or not.)

(42) $[\![\text{nɛ́}]\!] = \lambda p \lambda x.p$

In short, (42) helps make sense of otherwise puzzling asymmetries in how logophors behave in Gengbe attitude reports, and the suggestion made here now is that (42) is independently motivated by the broader distribution and function of the jussive marker in Gengbe paired with Zanuttini et al.'s (2012) property-theoretic approach to jussives. Despite these virtues, one might be reluctant to assign such a near-vacuous denotation to the jussive marker. In section 5

[5] Actually, it is an oversimplification to say that *nɛ́* comes with no person restriction: it disallows first-person subjects, both in matrix and in embedded contexts. The significance of this fact is unfortunately something that will have to be left for future research.

below, we entertain the alternative view that the jussive marker, in addition to contributing an individual argument, also has a modal semantics. First, though, we need to unpack our third proposal concerning the type-theoretic status of 'want' and 'believe'.

4.3. *Dʒí* 'want' can only combine with a property whereas *kắɖóédʒí* 'believe' can combine with either a proposition or a property

The third and final proposal that we need to substantiate is the idea that *dʒí* 'want' can only combine with a property whereas *kắɖóédʒí* 'believe' is type-theoretically flexible in being able to combine either with a proposition or with a property. This proposal goes against the recent grain in the formal semantics literature of treating *all* clauses in a type-theoretically uniform way, whether that be as propositions (as explored by Stephenson 2010) or as properties (as explored by Pearson 2013), regardless of whether the clause is embedded or not, controlled or not, or interpreted *de se* or not. But it is not a new idea either: Dowty (1985) proposes that non-control complements are proposition-denoting whereas control complements are property-denoting, which, as Dowty discusses, has as a consequence that some embedding verbs (those that disallow control) are type $\langle st,\ldots\rangle$, others (those that only accept control complements) are type $\langle\langle e,st\rangle,\ldots\rangle$, and still others (those that admit both control and non-control complements) are $\langle st,\ldots\rangle/\langle\langle e,st\rangle,\ldots\rangle$-flexible.

Here we would like to entertain a variant of Dowty's (1985) proposal whereby what determines whether the complement is proposition- or property-denoting is not whether it is controlled but rather what kind of mood marking it has. By way of independent motivation, consider the observation that English *want* admits nonfinite complements but not finite complements (43) whereas *believe* is flexible in admitting both kinds of complements (44).

(43) a. John **wants** [Bill **to be** happy].
b. *John **wants** [that Bill **is** happy].

(44) a. John **believes** [Bill **to be** happy].
b. John **believes** [that Bill **is** happy].

This situation bears a striking resemblance to that of Romance: 'want' is rigid in only accepting subjunctive complements to the exclusion of indicative complements, as seen in the Spanish and Italian examples in (45) and (46), respectively, whereas 'believe' gives rise to variability: it ordinarily takes an indicative complement in Spanish (47) and an subjunctive complement in Italian (48).

(45) Juan **quiere** [que Pedro {**sea**/***es**} feliz].
'Juan wants that Pedro be.SBJV/INDIC happy.' Spanish

(46) Gianni **vuole** [che Pietro {**sia**/***è**} felice].
'Gianni wants that Pietro be.SBJV/INDIC happy.' Italian

(47) Juan **cree** [que Pedro **es** feliz].
'Juan believes that Pedro is.INDIC happy.' Spanish

(48) Gianni **crede** [che Pietro **sia** felice].
'Gianni believes that Pietro be.SBJV happy.' Italian

We can encode these subcategorization facts via a cross-linguistic extension of the same type-theoretic machinery that supports our analysis of the Gengbe facts. In particular, suppose that cross-linguistically, 'want' rigidly selects for a property (49) whereas 'believe' flexibly selects for either a proposition or a property (50).

(49) $[\![\text{want}]\!] = \lambda P_{\langle e,st\rangle}\lambda x\lambda w.\forall w' \in \text{BEST}_{desire}(\text{DOX}(x,w))\text{: } P(x)(w')$ $\langle\langle e,st\rangle,\langle e,st\rangle\rangle$

(50) a. $[\![\text{believe}]\!] = \lambda p_{\langle st\rangle}\lambda x\lambda w.\forall w' \in \text{DOX}(x,w)\text{: } p(w')$ $\langle st,\langle e,st\rangle\rangle$
b. $[\![\text{believe}']\!] = \lambda P_{\langle e,st\rangle}\lambda x\lambda w.\forall w' \in \text{DOX}(x,w)\text{: } P(x)(w')$ $\langle\langle e,st\rangle,\langle e,st\rangle\rangle$

Then the subcategorization facts follow, as long as Romance subjunctive clauses and English nonfinite clauses (regardless of whether they are controlled or not) are property-denoting just like Gengbe jussive-marked clauses (51), whereas finite indicative clauses are proposition-denoting (52).

(51) Infinitives/subjunctive clauses
a. $[\![\text{PRO to be happy}]\!] = [\lambda x\lambda w\ .\ \text{x is happy in w}]$ $\langle e,st\rangle$
b. $[\![\text{Bill to be happy}]\!] = [\lambda x\lambda w\ .\ \text{Bill is happy in w}]$ $\langle e,st\rangle$
c. $[\![\text{Pedro sea feliz}]\!] = [\lambda x\lambda w\ .\ \text{Pedro is happy in w}]$ $\langle e,st\rangle$

(52) Finite indicative clauses
a. $[\![\text{Bill is happy}]\!] = [\lambda w\ .\ \text{Bill is happy in w}]$ $\langle st\rangle$
b. $[\![\text{Pedro es feliz}]\!] = [\lambda w\ .\ \text{Pedro is happy in w}]$ $\langle st\rangle$

To be sure, there is a rich set of empirical facts and a rich literature surrounding the question of what grammatical factors conspire to determine what kind of finiteness or mood marking a clause will have in a given environment. (See e.g. Portner and Rubinstein 2013 for a recent assessment.) Our type-theoretic proposal is intended not as a *replacement* for existing proposals about what semantic properties characterize indicative- vs. subjunctive-selecting verbs but rather as an *implementation* of any such proposal. It does not say anything interesting about *why* verbs have the type signature they do and hence ultimately needs to be embedded into a theory that does.

5. Harmonic modality?

It is crucial to our account of the data that the jussive marker *nɛ́* contributes an individual argument, and in section 4.2 above, we proposed that this is *all* the jussive marker does. But our analysis is also consistent with the view that *nɛ́* does more than just this. And given that this marker occurs in contexts associated with a priority semantics, we would like to entertain the possibility that *nɛ̋* is a priority modal in the sense of Portner (2007, 2009). The individual argument it contributes could then be understood naturally as an argument that helps determine the set of worlds that the modal quantifies over, as in (53) (the basic shape of (53), discounting the individual argument, is inspired by the approach to modals found in Kratzer 2013). According to (53), *nɛ̋* combines with a situation description *p* and returns a relation between individuals and situations. This relation is true of an individual *x* and a situation *s* iff all those worlds compatible with *x*'s priorities in *s* are worlds that contain a situation verified by *p*. (Actually, this is a simplification: technically, we need a circumstantial modal base and a priority-oriented ordering source: see Portner 2009:135. We suppress this detail here for ease of presentation.)

(53) $[\![\text{nɛ̋}]\!] = \lambda p_{\langle st\rangle}\lambda x\lambda s.\forall w' \in \textsc{priority}(x,s)\text{: } \exists s' \, [s' \leq w' \wedge p(s')]$
where $\textsc{priority}(x,s) = \{\forall w \mid w \text{ is compatible with x's priorities in s}\}$

This approach then has consequences for the compositional semantics of desire reports like (54).

(54) Ámá̋ **dʒí** [bé **Àkú nɛ̋** ɖù nű̋].
Ama want COMP Aku JUSS eat thing
'Ama wants Aku to eat.'

With modal meaning built into the jussive marker, we need to correspondingly shift the modality out of the desire predicate. In particular, we can adopt the semantics for *dʒí* 'want' in (55), thereby arriving at a meaning like (56) for the desire report in (54).

(55) $[\![\text{dʒí}]\!] = \lambda P_{\langle e,st\rangle}\lambda x\lambda s.\text{want}(s) \wedge \textsc{experiencer}(s) = x \wedge P(x)(s)$

(56) $[\![\text{Ama want COMP Aku JUSS eat thing}]\!] =$
$\exists s \, [\text{want}(s) \wedge \textsc{experiencer}(s)\text{=Ama} \wedge \forall w'\in\textsc{priority}(\text{Ama},s)\text{: } \exists s' \, [s' \leq w' \wedge \text{Aku eats in } s']]$
'There is a situation *s*, *s* is a wanting whose experiencer is Ama, and all those worlds compatible with Ama's priorities in *s* are worlds in which there is a situation in which Aku eats.'

This approach reflects a Kratzer 2013-style decompositional 'neo-Davidsonian' approach to clausal embedding (cf. also Moulton 2009; Bogal-Allbritten 2016; Grano 2016).[6] On this analysis, *dʒí ... nɛ̋* ('want ... JUSS') instantiates the same kind of harmonic modality that Kratzer (2013) points to in motivating her approach to clausal embedding, such as the examples in (57)–(58).

(57) It seems to us entirely **desirable** that there **ought to** be a constitutional amendment. (Kratzer 2013:slide 17)

[6] One notable way in which we depart from these previous approaches, though, is that the previous approaches treat the attitude predicate as composing with its clausal complement via Predicate Modification (or Restrict), whereas we treat it as composing with its complement via Functional Application. This is needed on our account in order for the attitude predicate to be able to regulate the type of its complement ('want' needing a property but 'believe' being compatible with either a property or a proposition).

(58) The urgency of the situation **requires** that the dig **must** continue regardless of the weather and comfort. (Kratzer 2013:slide 18)

In examples like (57)–(58), the bolded modals in the embedded clause seem to be redundant with the bolded embedding predicates. On Kratzer's decompositional approach to embedding, this redundancy is readily made sense of, because the modality is located solely on the modals and the embedding predicates merely serve to help fix the modal base(/ordering source) by supplying a situation variable.

A potential source of cross-linguistic support for the harmonic modality approach to (54) comes from the Yiddish and Yiddish English *want…should* locution, exemplified in (59)–(60).

(59) Ikh **vil** er **zol** geyn.
1SG want 3SG should go
'I want him to go.' (Yiddish, Sadock 2012)

(60) You **want** I **should** help you?
(see discussion at `http://languagelog.ldc.upenn.edu/nll/?p=11847`)

Here we see a striking parallel between Yiddish/Yiddish English and Gengbe in the sense that in both languages, 'want' routinely embeds a marker that, in matrix contexts, can be used to express priority semantics. If Yiddish (and Yiddish English) 'should' and Gengbe *nɛ̃́* are to have the same analysis, this means either that 'should' does not have a modal semantics but is rather merely an individual abstractor, or that Gengbe *nɛ̃́* does have a modal semantics, along the lines suggested here.

To recap, there are two ways of cashing out the proposal that *nɛ̃́* has the type-theoretic consequence of introducing an individual argument. On this first approach we entertained, it is a pure individual abstractor with no other content. On the second approach we entertained, it is a priority modal that introduces an individual argument which in turn helps determine the worlds that the modal quantifies over. Notably, the individual argument plays very different roles depending on which approach is taken: on the first approach, it corresponds to the hypothetical individual on whose To-Do List the relevant property is placed and who consequently bears an obligation to make the property true of herself. On the second approach, by contrast, it corresponds to the individual whose desires or goals make the content associated with the property a priority.

It will be beyond the scope of this paper to adjudicate between these two approaches, but a couple of issues at stake can be mentioned. One potential advantage of the modal approach is that it more readily makes sense of the fact that *nɛ̃́* can be embedded into a belief report in such a way that it has a transparent priority-oriented semantics, as in (61). On the individual abstractor approach, it is unclear why the mere status of the embedded clause as a property would give it a priority flavor. (It also bears noting that in examples like this, the modal approach commits us to positing an appropriate modal in the left-periphery of the embedded clause, just as Kratzer 2013 does for belief reports that do not contain an overt modal.)

(61) Ámǎ́ **kǎ́ɖóédʒí** [bé **Àkú nɛ̌́** ɖù nǔ́].
Ama believe COMP Aku JUSS eat thing
'Ama believes that Aku should eat.'

The two approaches also have different consequences for the illocutionary force of examples like (62). On the individual abstractor approach, (62) has a special illocutionary force in virtue of being property-denoting and the priority flavor is a consequence of this. But on the modal approach, (62) is just an assertion (proposition-denoting, the individual argument of the modal being, by hypothesis, speaker-bound in matrix contexts) and its priority flavor is a consequence of its modality. More research will be needed to determine what kind of illocutionary force (62) in fact has.

(62) Kòfí **nɛ̌́** ɖù nǔ́.
Kofi JUSS eat thing
'Kofi should eat.' / 'I want Kofi to eat.'

6. Conclusions

The central narrow conclusion of this paper is that a property analysis of Gengbe jussive clauses helps make sense of an otherwise puzzling interaction between embedding verb choice, mood choice, and antecedent choice for logophors. Of broader significance is the prospect of extending this property analysis to subjunctive and infinitival clauses on a cross-linguistic scale, thereby enabling a theoretical unification across superficially disparate but underlyingly related mood categories. In this connection, an important question that still needs to be addressed is: if we are correct in extending the property analysis of jussive clauses to subjunctive clauses and infinitives cross-linguistically, why do the specific puzzles we see in Gengbe not show up in more familiarly studied languages? We think that it is because Gengbe has two properties that are not typical among better studied languages. First, it has logophoric pronouns, which are crucial to the central puzzle. Second it has 'full' (in the sense of being 'finite' or 'non-truncated') clauses as complements to verbs like 'want'; if this were not the case, we might not expect to see overt logophors or overt mood markers in these complements and hence the puzzles would not arise. So the suggestion is that it is only when these two properties co-occur in a language that they conspire with the possibly universal type-theoretic principles entertained in this paper to give rise to the set of puzzling facts that we saw in section 2.

There is one final theoretical point to be made: we think that it is also in light of the two aforementioned properties of Gengbe that we see in Gengbe the recruitment of logophoricity to achieve syntactic control. In (63), repeated from (8) above, the subject of the bracketed clause is obligatorily identified with an argument of the immediately higher clause, which is precisely the hallmark of obligatory control in the sense of Landau (2000).

(63) (Àkú$_1$ bé Kòfí$_2$ bé) **Ámǎ́$_3$ dʒí** [bé **jè**$_{(*1/*2/)3/*4}$ **lá** ɖù nǔ́].
Aku say Kofi say Ama want COMP LOG POT eat thing
'(Aku said that Kofi said that) Ama wants to eat.'

This is significant for two reasons. First, it possibly constitutes evidence against Landau's

(2015:38) claim, following Culy (1994), that logophors never occur in obligatory control complements. If 'obligatory control complement' is to be defined in a non-circular way, it seems to us difficult to escape the conclusion that (63) instantiates a logophor in an obligatory control complement. Second, speaking more broadly, our analysis of (63) is consonant with the recent trend in control theory of not viewing controlled subjects as instantiations of a dedicated inaudible pronoun PRO but instead as a species of expression that enjoys wider grammatical currency such as minimal pronouns (Kratzer, 2009; Landau, 2015) or DP copies left behind by movement (Hornstein, 1999). Both the minimal pronoun approach and the movement approach give rise to the expectation that controlled subjects should be phonologically overt under some conditions (as overt pronouns or as pronounced copies, respectively). And also on both approaches, control is not a theoretically primitive notion but is rather an emergent consequence of the lexical items in the sentence and how they interact with each other, which is precisely how our theory treats Gengbe sentences like (63).

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Operating over (internal) 'covert-based' alternatives with scalar focus-sensitive particles: Evidence from Modern Hebrew[1]

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Abstract. This paper examines a range of readings found with the Hebrew focus sensitive particle *bixlal* and its accented version *BIXLAL* observed in Migron 2003, and in a series of works by Greenberg and Khrizman. Following ideas in these works the paper argues that *bixlal* is a member of the typology of *even*-like operators in Hebrew, along the unmarked particle *afilu*, and that the range of readings found with *BIXLAL* results from the fact that the same *even*-like operation is done over 'covert-based', and in particular degree-based and domain-based, alternatives. This parameter of variation is shown to be relevant for other scalar particles, both *even*-like and *only*-like, cross linguistically. The paper is finished by briefly examining another non-standard type of alternatives operated over by some scalar particles, namely speech act alternatives. The general conclusion is that 'type of alternatives' is a relevant parameter for scalar focus particles in natural language.

Keywords: *even*, *only,* scales, alternatives, focus, degrees, domains, gradable adjectives, multidimensional adjectives, NPIs, speech acts, typologies.

1. Introduction: Classical parameters of variations in typologies of *even*-like particles and the new parameter examined in this paper

The lexical entry of *even* is usually taken to be some version or other of (1) (cf. Horn 1969, Karttunen and Peters 1979, Rooth 1985, 1992, Herburger 2000, Guerzoni 2003, Chierchia 2013, etc.). In prose, (1) says that *even (C)(p)(w)* presupposes that *p* is stronger on a contextually given scale (e.g. it is less likely / more noteworthy) than all its distinct focus alternatives in C, and asserts that *p* is true:

(1) $||even||_{g,c} = \lambda C.\lambda p.\lambda w: \forall q \in C\ q \neq p \rightarrow p >_C q.\ p(w) = 1$
Where $C \subseteq ||p||^F \wedge ||p||^O \in C \wedge \exists q\ q \neq p \wedge q \in C$

This entry has been very prominent in the literature on scalarity and polarity sensitivity, but it also raised discussions and debates. A significant contribution to these debates comes from typological research of languages where more than one *even*-like operator exists. Such research identified a number of parameters along which *even*-like operators may vary, concerning, e.g. the high vs. low position of prejacent in the scale in the scalar presupposition and the logical properties of the licensing environment for the *even*-like particle**,** the scopal properties of the particle, the nature of the scale, the presence of an existential presupposition in addition to the scalar one, etc. (See, e.g. Rullmann 1997, Giannakidou 2007, Gast and van der Auwera 2011, Crnič 2011 for reviews and suggestions).

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The main goal of the present paper is to argue for the existence of yet another relevant parameter of variation, not discussed so far in the literature on overt *even*-like typologies, namely the ability / inability of the particle to operate over what we will call 'covert-based' alternatives. The main empirical support for the linguistic relevance of this parameter is a range of differences between two members of the *even*-like typology in Hebrew: the default *even*-like particle, *afilu*, and the particle *bixlal*. We will concentrate on a number of readings found with the accented version of *bixlal, BIXLAL*, observed in Migron 2003, Greenberg and Khrizman 2012a,b, Greenberg 2014, 2016b, which can be paraphrased as *very, in general, at all,* etc. Inspired by ideas in these works we claim that these readings can be derived by assuming that *BIXLAL* still denotes the same *even*-like operation as *bixlal*, but that instead of operating over standard focus alternatives, it operates over 'covert-based', and more specifically, over domain-based and degree-based alternatives to its prejacent.[2] This kind of operation will be shown to be relevant also for some *only*-like particles. More generally, then, the (in)ability to operate over 'covert-based' alternatives seems to be a relevant parameter of variation for scalar focus particles cross linguistically.

The paper is structured as follows: Section 2 presents the basic data to be accounted for, namely the membership of *bixlal* in the typology of *even*-like particles in Hebrew (along with the unmarked form, *afilu*), and the challenge posed by the special readings of *BIXLAL*. Section 3 proposes that these special readings should be derived by assuming that *BIXLAL* is an *even*-like operator over degree-based and domain-based alternatives, and illustrates the advantages of this proposal in sentences with one-dimensional and multidimensional adjectives. Section 4 briefly considers, and rejects, an alternative, intensifier-based analysis of *BIXLAL.* Section 5 takes a wider perspective and looks at other overt and covert *even*-like as well as *only*-like operators over degree and / or domain-based alternatives. In section 6 we briefly examine the existence of apparently non-scalar readings of *bixlal*, which we propose to analyze as *even*-like operations over speech acts alternatives. Section 7 concludes and summarizes more generally potential specifications of the 'type of alternatives' parameter for some scalar focus particles.

2. The data

2.1. *Bixlal* is a member of the family of *even*-like particles in Hebrew

The standard, default *even*-like particle in Hebrew is *afilu*. We propose, however, that like many other languages (see e.g. Giannakidou 2007, Crnič 2011, Gast and van der Auwera 2011), Hebrew has more than one member in this typology. In particular, following Greenberg 2014, Greenberg and Orenstein 2016, we propose that besides *afilu* Hebrew has at least three more members in this family, namely the high register particle *af,* the 'NPI' *ve-lu* (similar to the English *so much as*), and the particle *bixlal*, which will be the main focus of this paper.

The claim that *bixlal* is an *even*-like operator is not trivial, though, as it is never mentioned in dictionaries or traditional Hebrew grammars as a translation of *even,* along *afilu*. The reason seems to be that the most prominent uses of this particle are found in its accented version, *BIXLAL*, which, as discussed below, is not translated as *even* but as *very, in general, at all,*

[2] In Greenberg 2014 such alternatives are called 'internal', rather than 'covert-based'.

etc.[3] Nonetheless, as originally observed in Migron 2003, *bixlal* CAN be translated as *even*, and substituted by *afilu*. An example is (2):

(2) Context: Discussing Danny’s and Yosi’s great success in the competition:
Dani zaxa be-medalyat kesef, ve-yosi **afilu** / **bixlal** zaxa be-[zahav]$_F$/ #[bronza]$_F$
Danny won in-medal silver and-Yosi afilu / bixlal won in-gold bronze
“Danny won a silver medal, and Yosi even won [gold]$_F$ / # [bronze]$_F$”

In such sentences *bixlal* behaves like *afilu* and *even* in indicating that *p* is stronger than its alternative (*Yosi won gold* $>_c$ *Yosi won silver*). Moreover, like *even* and *afilu, bixlal* is infelicitous when *p* is weaker than its alternative (*Yosi won bronze* $<_c$ *Yosi won silver*).

Another property that *bixlal* shares with *afilu* is its scopal behavior with respect to surface negation: unlike English *even,* and just like Hebrew *afilu*, *bixlal* can scope either above a negated predicate, or below such a predicate, but not between negation and the predicate:[4]

(3) A: dani lo rakad ba-mesiba. ve-ma im yosi?
Danny not danced in-the-party and-what with Yosi
“Danny didn’t dance in the party. And what about Yosi?”
B: a. hu **afilu**/**bixlal** lo shar b. hu lo shar **afilu**/**bixlal** c. hu lo #**afilu**/#**bixlal** shar
he afilu/bixlal not sang he not sang afilu/bixlal he not afilu/bixlal sang
“He even didn’t sing” “He didn’t sing even” “He didn’t even sing” (intended)

Finally, there are cases where the only way to translate English *even* to Hebrew is by using *bixlal* (not *afilu*). Such cases are found when the particle associates with whole questions, as in Iatridou and Tetevosov’s (2016) examples of ‘our *even*’ in (4) and (5):

(4) A: Let’s meet at Oleana’s for dinner. B: What do they even serve / serve even?

(5) A: Did Olivia get the Fields Medal? B: Is Olivia even a mathematician?

Iatridou and Tetevosov propose that in such cases *even* does not associate with any focused constituent inside the prejacent (e.g. with the accented *mathematician* in (5)). Rather, it associates with the entire question, and indicates that the prejacent question (e.g. *What do they serve in the restaurant? / Is she a mathematician*) is the least likely to be ignorant about, or to be asked. Moreover, they propose that in languages like Russian and German the choice between ‘garden variety *even*’ and ‘our *even*’ over questions is lexically encoded, so that some *even*-like particles (Russian *daže* and German *sogar*) can only function as ‘garden variety’ *even,* whereas others (*voobšče* and *überhaupt*, respectively) operate over questions.[5]

Now crucially, in Hebrew only *bixlal*, not *afilu* can be used as ‘our *even*’ over questions:

[3] In addition, *bixlal* has another, apparently non-scalar reading, translated as *actually* by Migron 2003. We briefly discuss this reading in section 6 below.
[4] For space reasons, we do not attempt to explain this pattern here.
[5] Iatridou and Tetevosov’s (2016) analysis of *überhaupt* as an *even*-based operator thus differs from e.g. Anderssen’s (2006) analysis of this particle as a general domain widener and Rohas-Esponda’s (2014) analysis as marking a move to a higher QUD. We adopt their analysis for *bixlal* as well. See also section 6 for a brief discussion of *voobšče* and *überhaupt*.

(6) A: Let’s meet at Oleana’s for dinner
B: ma hem **bixlal / #afilu** magishim?
what they bixlal / afilu serve
“What do they even serve?”

(7) A: “Did Olivia get the Fields Medal?
B: Olivia **bixlal / #afilu** matematikait?
Olivia bixlal / afilu mathematician
“Is Olivia even a mathematician?”

Given this data, then, *afilu* is similar to German *sogar* and Russian *daže,* in being able to function only as ‘garden variety’ *even.* In contrast, *bixlal* seems more flexible, as it can denote both an *even*-like operation over whole questions, like German *überhaupt* and Russian *voobšče*, as well as function as ‘garden variety’ *even* (as in (2)).

The conclusion at this stage, then, is that *bixlal* is indeed a member of the Hebrew *even*-like family, alongside the default particle, *afilu*, and it shares with *afilu* and *even* the same lexical entry, namely (1) above.

2.2. The challenge: a variety of readings with *BIXLAL*

A challenge to the *even*-like analysis of *bixlal* is the fact that when it is accented (as *BIXLAL*) it induces a variety of readings which make it different from both *even* and *afilu.* As originally observed by Migron 2003, the most prominent of these readings is found when *BIXLAL* combines with negated predicates, and is paraphrased as *at all*, as in (8). Migron emphasizes, however, that *BIXLAL* is different from English *at all* in that it is not an NPI, since it can appear in matrix sentences or in Upward Entailing contexts, as in (9), where it is paraphrased as *in general*. Greenberg and Khrizman 2012a,b observe that in such contexts *BIXLAL* can be also be paraphrased as *very* (10), or *completely* (11):

(8) A: dani lo gavoha. ve-yosi? B: hu **BIXLAL** lo gavoha/ hu lo gavoha **BIXLAL**
Danny not tall and-Yosi he BIXLAL not tall / he not tall BIXLAL
“Danny is not tall. And Yosi?” “He is not tall at all”

(9) A: dani xaxam be-xeshbon. ve-yosi? B: hu **BIXLAL** xaxam.
Danny smart at-math and-Yosi he BIXLAL smart
“Danny is smart at math. And Yosi?” “He is very smart / smart in general”

(10) A: dani gavoha. ve-yosi? B: hu **BIXLAL** gavoha.
Danny tall and-Yosi he BIXLAL tall
“Danny is tall And Yosi?” “He is very tall”

(11) A: le-dani ein shum maxala. ve-yosi? B: hu **BIXLAL** bari.
to-Danny there is no disease and-Yosi he BIXLAL healthy
“Danny has no disease. And Yosi?” “He is completely healthy”

How should such readings be analyzed? It is possible, of course, to suggest that *BIXLAL* is many-way ambiguous, and that its semantics when accented is completely distinct from the *even*-like semantics we suggested that its unaccented version has. In the next section, however, we take another route. Based on preliminary suggestions in Migron 2003, Greenberg and Khrizman 2012a,b and Greenberg 2014, 2016b, we propose a more unified analysis of *bixlal* and *BIXLAL* where it denotes the same *even*-like operator in all its uses just like *even* and *afilu*, but varies in the type of alternatives it can operate over.

3. The proposal: An *even*-like operator over degree-based and domain-based alternatives

3.1. The core proposal

We suggest that *even, afilu* and *bixlal / BIXLAL* all have the semantics in (1) above, presupposing that their prejacent, *p,* is stronger on the relevant scale than all its contextually supplied focus alternatives, *q,* in C, and asserting that *p* is true. However, whereas given the data above, *even* and *afilu* can only operate over standard, 'Roothian' focus alternatives, *BIXLAL* can operate over 'covert-based', and in particular degree- and domain-based alternatives when it is accented.[6]

Operating over 'Roothian' alternatives is done in the standard manner: the alternatives to *p* are identical to it, besides an overt, focused element (which is usually accented), which is substituted by another overt element of the same semantic type. For example, in (2) above, where *p* is *Yosi won [gold]$_F$,* the alternatives are derived by substituting the overt focused element 'gold' with other overt elements of the same semantic type, yielding e.g. *Yosi won silver, Yosi won bronze,* etc.

In contrast, 'covert-based' alternatives are derived by letting the operator associate with a covert element in *p*. In such cases the alternatives to *p* differ from it by the identity of this covert element, while crucially, all overt material in *p* stays fixed in *q*. This leads to a situation where the alternatives to *p* differ from it only in their interpretation, though on the surface, i.e. in terms of their overt material, they seem identical to it.

3.2. Illustrations with one-dimensional adjectives

To illustrate the proposal, consider first the way *BIXLAL* is interpreted in (10), with the one-dimensional adjective *tall*. We suggest that in this case both the prejacent of *BIXLAL, p* and the contextually salient alternative, *q,* are of the form: *Yosi is POS tall*, which, following, e.g. Kennedy and McNally 2005 has the interpretation in (12), saying that the degree to which Yosi is tall is at least as high as the standard of tallness:

[6] An obvious question is why the operation over covert-based alternatives is found only with the accented version of the particle, *BIXLAL*. Based on ideas in Egg and Zimmermann 2011, and in Greenberg and Khrizman 2012a,b, Greenberg 2014, Greenberg 2016b suggests an information-structure based explanation for this pattern. But describing this explanation is beyond the scope of this paper.

(12) $p = \exists d\ [d \geq \boldsymbol{stand}_{tall} \wedge tall(Yosi,d)]$
$q = \exists d\ [d \geq \boldsymbol{stand}_{tall} \wedge tall(Yosi,d)]$

This, of course, raises an immediate question: If p and q are identical, how can the scalar presupposition ($p >_c q$) of the *even*-like operator *BIXLAL* be met? The answer, we suggest, is that the covert ***stand*** variables in p and q are assigned two different values.[7] In q we get $\boldsymbol{stand}_{default}$ – constructed based on the value to the standard variable in the preceding sentence *Danny is POS tall*. In contrast, in p we assign ***stand*** a higher value, $\boldsymbol{stand}_{high}$, such that $\boldsymbol{stand}_{high} > \boldsymbol{stand}_{default}$. This allows p to end up being stronger than q, as required in the scalar presupposition, and as seen in (13). The effect is intuitively paraphrased in (14):

(13) $\exists d\ [d \geq \boldsymbol{stand}_{high,tall} \wedge tall(Yosi,d)] >_c \exists d[d \geq \boldsymbol{stand}_{default,tall} \wedge tall(Yosi,d)]$

(14) A: Danny is tall relative to the contextually default standard, $\boldsymbol{stand}_{default}$, and what about Yosi?
B: He is even tall relative to the higher standard, $\boldsymbol{stand}_{high}$,

(10), as well as its intuitive paraphrase in (14) lead to the inferences that Yosi is very tall, and that he is taller than Danny. To derive these inferences we suggest that, since in the salient sentence (*Danny is POS tall*) the relevant standard being used is the lower one, $stand_{default}$, and since, a higher standard, $stand_{high}$ is made salient in the prejacent of *even,* the proposition $\exists d[d \geq \boldsymbol{stand}_{default,tall} \wedge tall(Danny,d)]$ raises the scalar implicature that the stronger alternative, $\exists d[d \geq \boldsymbol{stand}_{high,tall} \wedge tall(Danny,d)]$, is false. We end up then, with the understanding that Danny is tall relative to the default standard, but not relative to a higher standard. Hence, Yosi, who is taken to be tall relative to the higher standard (due to the scalar presupposition of *BIXLAL*), is understood to be taller than Danny, as well as 'very tall'.

Turning now to the *at all* reading of *BIXLAL* in (8), found with a negated predicate, in this case we take both p and q to be of the form in (15), asserting that it is not the case that the degree to which Yosi is tall is at least as high as the standard of tallness. Then, to satisfy the scalar presupposition of *BIXLAL* ($p >_c q$), we assign the standard variable in p a LOWER value, $\boldsymbol{stand}_{low}$, than the salient standard in q, $\boldsymbol{stand}_{default}$. We thus end up with the presupposition in (16), and with the intuitive paraphrase of (8) in (17):

(15) $p = \neg\exists d\ [d \geq \boldsymbol{stand}_{tall} \wedge tall(Yosi,d)]$
$q = \neg\exists d\ [d \geq \boldsymbol{stand}_{tall} \wedge tall(Yosi,d)]$

(16) $\neg\exists d\ [d \geq \boldsymbol{stand}_{low,tall} \wedge tall(Yosi,d)] >_c \neg\exists d\ [d \geq \boldsymbol{stand}_{default,tall} \wedge tall(Yosi,d)]$

(17) Danny does not reach the contextually salient standard of tallness, $\boldsymbol{stand}_{default}$, Yosi does not even reach a lower standard, $\boldsymbol{stand}_{low}$., i.e. he is not tall at all.

[7] See Greenberg (to appear) for a more detailed analysis, where *BIXLAL* associates with the covert comparison class argument of *POS*.

3.3. Illustrations with multidimensional adjectives

We would now like to derive the readings found when *BIXLAL* appears in sentences with multidimensional adjectives, e.g. with *smart* and *healthy*, as in (9) and (11) above.

To do that we start by following Sassoon 2013, 2016 in assuming that multidimensional adjectives (*healthy, ill, smart,* etc.) involve cardinality measurement of 'respects' or 'dimensions' (e.g. *healthy / ill w.r.t. blood pressure / sugar level, John is smart w.r.t. math / humanities*, etc.). Each of the dimensions is itself a gradable property, introducing its own scale and standard degree, similarly to the standard degree used for one-dimensional adjectives like *tall*. We will henceforth call this standard degree $\boldsymbol{stand_d}$, to distinguish it from another standard operative with multidimensional adjectives, namely $\boldsymbol{stand_n}$**.** This latter standard is taken by Sassoon to be the standard number of dimensions required to be satisfied with each multidimensional adjective. This standard number, $\boldsymbol{stand_n}$, is sometimes lexically determined: for example, Sassoon argues that by default, to be healthy is to reach the standard degree of health in ALL relevant dimensions, e.g. blood pressure and sugar level and heart condition etc. In contrast, to be ill is to reach the standard degree of illness is at least SOME dimension. *Healthy* and *ill*, then, can be classified as 'universal' and 'existential' multidimensional adjectives, respectively. In other cases, the standard number of dimensions is contextually determined. For example, to be smart is to be smart relative to a contextually determined number of dimensions (e.g. math, history, linguistics, etc.).

Given these ideas, then, we can assume that in the 'positive form' of a sentence like *Yosi is A* (where A is a multidimensional adjective) there is a covert *POS,* as in (18), and that such a sentence is interpreted as in (19):

(18) *Yosi is POS A* (where *A* is a multidimensional adjective)

(19) $\exists n\ [n \geq \boldsymbol{stand_{n,A}} \wedge |\lambda G.G \in \mathrm{Dim}_A \wedge G \in \boldsymbol{D} \wedge \exists d\ [d \geq \boldsymbol{stand_{d,G}} \wedge G(Yosi,d)]| \geq \mathrm{n}\ ]$

In words, such a sentence is true iff there is a number, n, of gradable dimensions G which are relevant dimensions of A (i.e. members of the domain $\underline{\mathbf{D}}$) for which Bill's degree exceeds the standard degree, namely $\underline{\boldsymbol{stand_d}}$. And this number $\boldsymbol{n}$ exceeds the standard number of dimensions, namely $\underline{\boldsymbol{stand_n}}$, in the domain of relevant dimensions for A**.**

The important point for us now is that (19) has three contextual covert variables, namely the underlined $\underline{\boldsymbol{stand_d}}$, $\underline{\boldsymbol{stand_n}}$ and $\underline{\boldsymbol{D}}$. Since we take *BIXLAL* to be an *even*-like operator over covert-based alternatives, we predict that when it is present each of these three covert variables can be in principle exploited to create such 'covert-based' alternatives.

The prediction is indeed borne out. To illustrate that consider first (9) above. Here we can exploit the variability of either $\underline{\boldsymbol{stand_d}}$ or $\underline{\boldsymbol{stand_n}}$. This gives us (at least) three possibilities. First, the alternatives can vary w.r.t. the value of $\underline{\boldsymbol{stand_d}}$, assigning a higher value to this variable in p than in q. The resulting interpretation is that Danny is smart-w.r.t.-math relative to the contextually salient standard, and Yosi is even smart-w.r.t.-math relative to a higher standard. Hence Yosi is considered <u>very smart (w.r.t.-math)</u>, e.g. his grades at math are higher. This reading can be intuitively paraphrased as in (20):

(20) A: Danny is smart (at math). He always gets an A in the math exams.
B: And Yosi is even VERY smart (at math). He always gets an A+ in these exams.

The alternatives can also vary w.r.t. the value of ***<u>stand_n</u>***, – assigning a higher value to this variable in *p* than in *q*. This can be achieved in two ways, and lead to two readings: first, Yosi can end up being smart with respect to an additional dimension (besides math), so the resulting interpretation is that Danny is smart-w.r.t.-one-dimension (i.e. smart-w.r.t.-math) and Yosi is even smart with respect to two dimensions, e.g. with respect to both math and history. Alternatively, Yosi can end up being smart w.r.t. all (relevant) dimensions, leading to the interpretation that Danny is smart-w.r.t.-one-dimension (i.e. smart-w.r.t.-math) and Yosi is even smart with respect to ALL (relevant) dimensions (math, history, art, linguistics, …). This option is what leads to the 'in general' use of *BIXLAL*. The two options can be now more intuitively paraphrased as in B's two answers in (21):

(21) (Context: Students in this college study math, biology, physics, history, philosophy and linguistics)
A: Danny is smart. He has great grades at math.
B1: And Yosi is even VERY smart. He is also great in history.
B2: And Yosi is even VERY smart. He is great in all fields, i.e. smart in general.

The third variable that can be exploited to yield covert-based alternatives with *BIXLAL* is the domain restriction variable, ***D***. Consider for example (11) above, with the 'universal' multidimensional adjective *healthy*, in the following context: we are organizing a challenging trip, and in order to join this trip, all candidates should be healthy, i.e. should have normal values along important medical parameters, namely blood pressure, sugar level and heart functioning. In this case we take *p,* the prejacent of *BIXLAL* (*Yosi is POS healthy*)*,* to be stronger than its apparently identical alternative *q* (which is again *Yosi is POS healthy*), similarly to what we did with the other cases in (8)-(11). Here, though, we cannot take *p* to be stronger than *q* due to a higher value assigned to $\boldsymbol{stand_d}$, since there is no specific dimension of health where Yosi's degree is claimed to be higher. Nor do we assign $\boldsymbol{stand_n}$ a higher value, since the value for this standard in A's utterance is already maximal, due to the default specification of this standard with adjectives like *healthy:* i.e. Danny is already considered healthy with respect to <u>all</u> relevant dimensions (blood pressure, sugar level and heart functioning). Instead, to make *p* stronger than *q* in this case we can assign the domain variable, ***D***, two distinct values: $D_{default}$ in *q,* D_{wide} in *p*, where $D_{default} \subset D_{wide}$. Given this suggestion, then, the intuitive paraphrase of (11) is as in (22):

(22) Danny is healthy with respect to all dimensions of health relevant for the trip, i.e. all dimensions in $D_{default}$, and Yosi is even healthy w.r.t. additional, less relevant dimensions, i.e. all dimensions in the wider domain, $D_{wide.}$

To support this proposal, we can remind ourselves what is independently known about domain widening in other constructions. Following e.g. Kadmon and Landman 1993 ideas on *any* (as in *I don't have any potatoes*), we take domain **restriction** to be used in order to exclude 'irrelevant' entities (e.g. small or rotten potatoes). Domain **widening** thus typically indicates that such entities can be now considered relevant. This seems to be exactly what happens in (11) as well. This sentence can be very naturally be continued with "He doesn't even have a mild cold". In contrast, continuing (11) with "He doesn't even have cancer" will sound very odd, as predicted.

We can now also predict that with 'existential' multidimensional adjectives (like *ill*), *BIXLAL* will not yield domain widening. This is because such an operation will not make *p* stronger than its alternative (cf. e.g. discussions of Kadmon and Landman 1993, Krifka 1995, Chierchia 2013 on *any*). Indeed, unlike (11) with *healthy,* (23) with *ill* can be naturally continued with "He even has cancer", but continuing it with "he even has a mild cold" sounds very odd:

(23) A: dani xole, ve-yosi? B: hu **BIXLAL** xole.
Danny ill and-Yosi? he BIXLAL ill
"Danny is ill. And Yosi?" "He is very ill"

Notice also that *BIXLAL* can induce domain widening in the Hebrew correlate of the Kadmon and Landman's 1993 example in (24) with a negated predicate, yielding again an *at all* reading. In this case, too, we suggest that *BIXLAL* denotes an *even*-like operation over the covert domain variable, ending up with the intuitive paraphrase in (25):

(24) ein li tapuxey adama BIXLAL
not-have to-me potatoes BIXLAL
"I don't have potatoes at all"

(25) I don't have potatoes in $D_{default}$, and I don't even have less relevant potatoes in D_{wide}.

To summarize so far, we argued that *BIXLAL* is an *even*-like operator, similar to English *even*, and Hebrew *afilu*, and that the range of readings found with it can be derived by assuming that it operates over a special kind of alternatives, namely 'degree-based' and 'domain-based' alternatives. What all these cases have in common is an abstract / structural property: the ability to apply the *even*-like operation over 'covert-based alternatives' (cf. Erlewine 2014 on association with covert variables). Thus, wherever its prejacent contains a covert contextual variable, *BIXLAL* can exploit it by assigning this variable a distinct value which will make *p* stronger than *q*, as required by the scalar presupposition.

4. Rejecting an intensifier-based analysis of *BIXLAL*

Since many of the readings found with *BIXLAL* seem to lead to some sort of intensification, one might wonder whether, instead of claiming that this particle is a special *even*-like operator over special, covert-based alternatives, we can come out with a simpler analysis, namely that *BIXLAL* is a flexible intensifier. There are two reasons, however, why such an analysis cannot work, both have to do with properties that *BIXLAL* shares with *even / afilu* which set it apart from intensifiers. These are the scopal interaction of *BIXLAL* with negation and its sensitivity to standards of comparison.

Above we have already noted that the unaccented particle *bixlal* behaves like *afilu* with respect to surface negation. In particular, we saw in example (3) above, that both particles can precede surface negation, and can appear after the neg+predicate combination, but cannot appear between negation and the main predicate. As can be seen now in (26), *BIXLAL* behaves in exactly the same way. In contrast, the scopal behavior of Hebrew intensifiers with respect to surface negation is much more flexible. This can be seen, for example, in the behavior of *me'od* ('very') in (27):[8]

(26) A: dani lo gavoha, ve-yosi?
Danny not tall and-Yosi
"Danny is not tall. And what about Yosi?"
B: a. hu BIXLAL lo gavoha b. hu lo gavoha BIXLAL c. #hu lo BIXLAL gavoha
he BIXLAL not tall he not tall BIXLAL he not BIXLAL tall
"He is not tall at all"

(27) A: dani lo gavoha, ve-yosi?
Danny not tall and-Yosi
"Danny is not tall. And what about Yosi?"
B: a. hu ME'OD lo gavoha b. hu lo gavoha ME'OD c. hu lo ME'OD gavoha
he very not tall he not tall very he not very tall
"He is very not tall" "He is not very tall" "He is not very tall"

In addition, *BIXLAL* shares with *afilu*, as well as with English *even,* another interesting property which sets it apart from intensifiers. In (10) above, for example, ('*Danny is tall, and Yosi is BIXLAL* ("very") *tall*'), the presence of *BIXLAL* in B's utterance immediately leads to the inference that Danny, mentioned in A's utterance is tall as well. Crucially, this inference is present not only when Danny's tallness is explicitly asserted, as in (10), but also in (28), which immediately entails that being 1.75m tall is considered tall. This is indicated by the infelicity of the continuation "He is not that tall" in A's utterance. Indeed, when *BIXLAL* is absent this inference completely disappears, and the first sentence can be naturally continued with "He is not that tall":

(28) A: dani hu 1.75 (#hu lo gavoha), ve-yosi? B: hu **BIXLAL** gavoha
Danny is 1.75 he not tall and-Yosi he BIXLAL tall
"Danny is 1.75m tall (he is not tall), and Yosi?" "He is even VERY tall"

This makes *BIXLAL* different from intensifiers like English *very* and Hebrew *me'od*. For example, the mere presence of *me'od* ('very') or *mamash* ('really') in (29) does not lead to any inference that being 1.75m tall is considered 'tall', and A's utterence is perfectly compatible with the continuation "He is not tall':

(29) A: dani hu 1.75. hu lo gavoha, ve-yosi? B: hu MEOD / MAMASH gavoha
Danny is 1.75 he not tall and-Yosi he very / really tall
"Danny is 1.75m tall (He is not tall), and Yosi?" "He is VERY / REALLY tall"

Crucially, the unique inference found with *BIXLAL* in (28) makes it similar to English *even*, as observed in Greenberg 2015, 2018. Consider (30) and (31):

[8] The behavior of the intensifier *me'od* ('very') in this respect seems typical of Hebrew intensifiers in general, and found also with *mamash* ('really') or *le-gamrey* ('completely') (although the latter is limited to modify Upper closed adjectives, cf. Kennedy and McNally 2005).

(30) A: Danny is 1.75m tall.
B1: and Yosi is taller.
B2: and Yosi is even taller.

(31) A: Danny is 1.75m. tall
B1: and Yosi is 1.78m.
B2: and Yosi is even 1.78m.

It is well known that comparatives based on relative adjectives, as in B1's answer in (30), do not entail the positive form of the adjectives they are based on, for neither the source nor the target of the comparison (e.g. Kennedy and McNally 2005). Indeed, *Yosi is taller than Danny* does not entail or even imply that Yosi or Danny is tall, and can be naturally continued with *… but both are short.* The interesting thing happens in B2's answer, with *even*: here, Greenberg 2015, 2018 observes, the presence of *even* leads exactly to these entailments. Indeed, continuing *Yosi is even taller* with *... but both are short* leads to infelicity.[9] As can be seen in (31) this effect is not limited to comparatives. Here too the presence of *even* in B's utterance entails that being 1.75m as well as being 1.78m are considered tall. Hebrew *afilu* yields exactly the same effects as *even* in such cases.

Based on such data, Greenberg 2015, 2018 proposes that for *even p* to be felicitous, both *p* and its alternatives *q* must intuitively 'lead to' a degree of a scale associated with a gradable property G, which is at least as high as the standard for this gradable property. This observation is not accounted for by the traditional semantics for *even*, according to which *p* should be only required to be stronger (less likely / more noteworthy) than *q*. Combining this observation with several other pieces of data which pose challenges for the popular 'comparative likelihood' view of *even* (see, e.g., Greenberg 2016a, 2018 for discussion), Greenberg offers a revised, 'gradability-based' semantics for *even*, which is sensitive to standards of comparison along a contextually supplied scale. Reviewing this proposal in detail is beyond the scope of this paper. The important point at this stage is that in terms of sensitivity to standards, *BIXLAL* seems to behave exactly like *even* and *afilu*, and unlike intensifiers. This, together with its behavior with surface negation, further supports the analysis of *BIXLAL* as an *even*-like particle, as suggested above.

5. Some cross-linguistic / cross-constructional support for the linguistic reality of the operation over 'covert-based' alternatives

We proposed that *BIXLAL* is not an intensifier, but an *even*-like operator, which unlike English *even* and Hebrew *afilu* operates over 'covert-based', namely degree-based and domain-based alternatives. More generally, we take the data in sections 3 and 4 to indicate that the ability / inability to operate over such 'covert-based' alternatives is a relevant parameter for *even*-like operators in Hebrew. But is Hebrew the only language where operation over such 'covert-based' alternatives is possible? Clearly our proposal would be more convincing if we find more manifestations of this parameter. Luckily, the answer seems to be positive.

[9] Umbach 2009 notes a similar effect with German *noch*. We believe, however, that the mechanism involved is different.

One type of candidate is the covert *even* operator argued to be involved in the semantics of some NPIs, as in Krifka 1995 and Chierchia 2013. For example, Chierchia 2013 takes minimizers like *give a damn* to involve the covert *even*-like operator *E*. *Give a damn*, according to Chierchia's proposal, expresses the property of caring to the most minimal degree, namely $\lambda x \exists s\ care(x,s,d_{min})$, and it obligatorily triggers degree-based alternatives of the form $\lambda x \exists s\ care(x,s,d')$, where $d' > d_{min}$. Similar considerations apply to expressions with *at all*,[10] which also triggers degree-based alternatives. These obligatorily triggered alternatives must be operated upon ('exhaustified'), and Chierchia argues that what operates over them is the covert *even*-like operator *E*, which requires its associate to be stronger (e.g. less likely) than all alternatives. Chierchia shows how such an operation is only licensed in Downward Entailing contexts, hence the NPI-hood of *give a damn* and *at all*.[11]

In addition to this covert *even*-like operator over covert degree-based alternatives with *at all,* Chierchia proposes that some NPIs, e.g. *any,* involve a covert operator over domain-based alternatives as well, namely the *only*-like operator *O* (or *exh*). For example, a sentence like *I don't have any potatoes* has a similar assertion to that of *I don't have potatoes,* namely $\neg\exists x\ Potato\ (x) \wedge D(x) \wedge Have\ (I, x)$, but it obligatorily triggers subdomain alternatives of the form $\neg\exists x\ Potato\ (x) \wedge D'(x) \wedge Have\ (I, x)$, where $D' \subset D$. These alternatives then must be exhaustified by the covert *only*-like operator *O*, which rejects all stronger alternatives. This is only licensed in Downward Entailing contexts, hence the NPI-hood of *any.* We can see, then, that in Chierchia's 2013 theory the covert *only*-like and *even*-like operators are allowed to operate over covert domain-based and degree-based alternatives, namely the type of alternatives Hebrew *BIXLAL* operates over, given the analysis developed above.

In addition to these covert operators we can also find potential candidates for being overt operators over such covert-based alternatives. One such particle is the Hindi *bhii.* Lahiri 1998 argues that when *bhii* combines with the numeral *ek* ('one') it yields numeral-based alternatives (e.g. *one, two, three*), whereas when it combines with the indefinite *koi* it seems to associate with the 'contextually weakest predicate'. Chierchia 2013 reinterprets this observation and proposes that in this case *bhii* expresses an *even*-like operation over domain-alternatives, similarly to what we proposed above for *BIXLAL*.

The Russian *voobšče* is another potential candidate for being an overt *even*-like operator over covert-based alternatives. Above we already saw Iatridou and Tetevosov's 2016 claim that *voobšče* expresses an *even*-like operation over questions. But Iatridou and Tetevosov 2016 mention in a footnote that it can yields an *at all* reading with negated predicates, as in (32). Moreover, *voobšče* seems to also yield a *very / -er than* reading in UE contexts (cf. Miashkur 2017a,b), as in (33):

[10] According to Chierchia 2013, though, *at all* involves 'scale reversal' as well.

[11] Our analysis of *BIXLAL* above thus makes two contributions to this analysis of *at all*: on the one hand, it supports the general line of an *even*-based analysis of *at all:* in particular, since *BIXLAL*, which is independently analyzed above as an *even*-like operator, is the only way to express *at all* in Hebrew, we have overt evidence that the semantics of *at all* indeed involves an *even*-like semantics. On the other hand, our analysis of *BIXLAL* seems to show that there are maybe two strategies for deriving *at all* readings cross linguistically: in contrast to Chierchia's 2013 analysis of English *at all,* Hebrew *BIXLAL* as *at all* is NOT taken as the alternative-triggering expression which then necessitates a covert *even*-like operator to operate over these alternatives. Instead, the Hebrew *at all,* i.e. *BIXLAL,* is the (overt) *even*-like operator itself.

(32) Lev **voobšče** ne čital "Devida Kopperfil'da"
Lev voobšče NEG read.PST David Copperfield
"Lev did not read 'David Copperfield' at all" (Iatridou and Tetevosov 2016)

(33) A: Džon 1.85m. A Bill? / Čto nasčet Billa?
John 1.85m but Bill / what on account of Bill
"John is 1.85m. And what about Bill?"
B: On **voobšče** vysokij.
he voobšče tall
"He is even very tall / taller"

These readings are not available with the standard *even*-like operator in Russian *daže,* and they can be analyzed in a similar fashion to the operation over degree-based alternatives with *BIXLAL* proposed above. Notice also that German *überhaupt*, which was analyzed as 'our *even*' over questions in Iatridou and Tetevosov 2016, has been reported to yield *at all* and *in general* readings too (cf. Anderssen 2006, Rojas Esponda 2014). Given our analysis of *BIXLAL* above we propose to analyze these uses of *überhaupt* too as involving an *even*-like operation over covert-based alternatives.[12]

Finally, there seem to also be attested overt *only*-like operators over 'covert-based' alternatives, for example, the Hebrew exclusive particles *be-sax ha-kol* and *STAM*, discussed in Orenstein and Greenberg 2014, Orenstein 2016, and Greenberg and Orenstein 2016. We will concentrate here on *be-sax ha-kol*, which can express both a regular exclusive reading, similar to the default *only*-like operator, *rak*, as well as an 'approximative' reading, similar to that found with *more or less*. Compare, for example, *rak* and *be-sax ha-kol* in (34a,b):

(34) <u>Context</u>: John and Mary booked a room in a hotel and asked that the room will be clean, large, with view to the sea. After John checks the room he tells his wife:
a. ha-xeder **rak** naki
the-room rak clean
"The room is only clean"
b. ha-xeder **be-sax ha-kol** naki
the-room be-sax ha-kol clean
"The room is only / more or less clean"

In (34a), with *rak* we get a regular scalar reading of exclusives, rejecting standard, 'Roothian' focus alternatives which are stronger than the prejacent, similarly to what we get with English *only* or *just* (cf. Coppock and Beaver 2014). This yields the intuitive paraphrase in (35a). In contrast, with *be-sax ha-kol* we can also get a new 'approximative' reading, intuitively paraphrased in (35b). Orenstein and Greenberg 2012, 2014, Orenstein 2016, Greenberg and Orenstein 2016 argue that under this approximative reading *be-sax ha-kol* is still an exclusive operator, but that what is rejected is a degree-based alternative. In particular, the proposal is that both the prejacent of *be-sax ha-kol, p,* and the alternative *q* are of the same form: *The room is POS clean,* namely, $\exists d[d \geq \mathbf{stand}(clean,C) \wedge clean(the\ room,d)]$, but the standard variable in

[12] Notice, though, that the range of interpretations *überhaupt* induces is more limited than with both *bixlal* and *voobšče*. A full analysis of these particles is beyond the scope of this paper (but see Miashkur 2017a,b for a fuller picture of *voobšče* vs. *daze*).

p is assigned a lower value than the default value in *q,* which is the maximal degree of cleanness. The resulting interpretation is that the room is not clean relative to the maximal standard, but clean relative to a lower standard, similarly to *more or less clean*.

(35) a. The room is only clean and not more than that: not clean and large, not clean with view to the sea, etc.
b. The room is only more or less clean, and not more than that: it is not maximally clean.

The operation over 'covert-based' alternatives, then, can be added to the list of parameters along which *only*-like particles vary (cf. Tomaszewicz 2012, Coppock and Beaver 2014, Orenstein and Greenberg 2014, Orenstein 2016, Greenberg and Orenstein 2016). More generally, the analysis of Hebrew *BIXLAL* as an *even*-like operator over covert-based alternatives, can be positioned in a wider cross linguistic and cross constructional context. The emerging picture is that the (in)ability of scalar operators to operate over 'covert-based' alternatives should be taken as a relevant parameter of variation in this wider typology.

6. A direction for further research: Scalar operators over a range of speech acts alternatives

A challenge to our *even*-like analysis of *bixlal* and *BIXLAL* is the existence of some uses of *bixlal*, originally pointed out by Migron 2003, which on the surface do not seem scalar at all. Consider, for example, (36):

(36) A: Rina carfatiya?
Rina French
"Is Rina French?"
B: lo. Hi bixlal britit
no she bixlal British
"No way. She is actually British." (cf. Migron 2003)

In (36) *bixlal* is not translated as *even*. Moreover, the prajacent of *bixlal*, *She is British*, does not stand in any scalar relation to the salient alternative, *She is French*. In particular, (36) does not seem to indicate that being British is 'stronger', e.g. less likely or more noteworthy, than being French. Indeed, Migron takes this use of *bixlal* to be translated as *actually,* and to merely indicate the shift from one alternative to the other in an unordered set of alternatives.

Given this data one can take *bixlal* to be simply ambiguous between a scalar and a non-scalar reading (cf. also Kadmon and Sevi 2014 for a suggestion). But perhaps we can still analyze this use of *bixlal* under the *even*-like semantics proposed above. The crucial observation we would like to make in this connection, following Greenberg and Khrizman 2012b, Greenberg 2014, 2016b, Greenberg and Orenstein 2016, is that the presence of *bixlal* in (36) indicates a correction speech act, which crucially involves strong / significance denial. Intuitively, in (36) we take the proposition that Rina is British to correct and as part of this correction to strongly deny the proposition that Rina is French. This effect makes this 'corrective' use of *bixlal* different from that of *actually* (which indeed seems to merely indicate a shift of one proposition in the discourse to an alternative one).

As a support of this observation, notice that if the denial is explicitly marked as being minor, the use of *bixlal* is infelicitous. For example, in (37) *bixlal* is only felicitous if the speaker takes having turquoise eyes as being significantly different from having blue eyes:

(37) A: le-dani yesh einaym kxulot
to-dani there-is eye blue
"Danny has blue eyes"
B: #lo be-diyuk / mamaS lo. yesh lo bixlal eiynam be-ceva TURKIZ
not precisely really not there-is to-him bixlal eyes in-color turquoise
#Not precisely / Absolutely not. He actually has TURQUOISE eyes"

As a preliminary proposal, then, we suggest that *bixlal* in (36) and (37) is another manifestation of discursive-*even*, similar to 'our *even*', *voobšče, überhaupt,* and *bixlal* over questions, discussed in Iatridou and Tetevosov 2016 and in section 2 above. The difference is that instead of operating over questions alternatives, in the cases discussed here we get an *even*-like operation over denials, indicating that the denial is 'stronger' on the relevant scale than alternative denials. Thus, (36)-(397) can be paraphrased as (38)-(39), respectively:

(38) Not only is Mary not French, she is even British!

(39) Not only does John not have blue eyes, he even has turquoise eyes!

Interestingly, we find parallel behavior of Russian *voobšče*, expressing an *even*-like operation over denials as well, as in (40) (K. Khrizman, and O. Miashkoor p.c.):

(40) A: ty kak istinnyj gruzin dolzhen ocenit' eto vino
you as real Georgian must appreciate this wine
"Being a genuine Georgian, you should be able to appreciate this wine"
B: ty chto??? kakoj ja gruzin… ya voobšče tatarin
you what what I Georgian I voobšče a Tatar
"What's wrong with you? I am not Georgian, I am a Tatar."

Moreover, in addition to these *even*-like operators over speech acts, it seems that there are also *only*-like particles which can operate over speech act alternatives. First, similarly to 'our *even*' the exclusive *only* seems to be able to operate over questions, as in (41), where it indicates that the question "When will he arrive?" is the only (relevant) thing the speaker is ignorant about. In addition, Greenberg and Orenstein 2016 point out that exclusives like *only / just* seem to be able to operate over denial speech acts, as in (42), indicating that the only thing to deny in the statement that Mary is a great teacher is that she speaks very quietly. In both cases the exclusive gives a similar effect to the adversative particle *but.* Finally, Wiagand 2016 discusses an 'unexplanatory' use of *just,* as in (43), indicating that the speaker does not know the reason or cause for the fact that the lamp broke (beyond a minimal reason or cause), and analyzes it as operating over speech act alternatives as well:

(41) When John is here we will go to the movies. Only when will he exactly arrive?

(42) Mary is a great teacher. She just speaks so quietly.

(43) I was sitting here and the lamp just broke (Wiagand 2016)

An important task, then, is to find ways to capture the data concerning both the *only*-like and the *even*-like operations over the full range of speech acts alternatives in a precise and systematic way. For space reasons we leave this task for further research (cf. Iatridou and Tetevosov 2016, Wiagand 2016 and Daniels 2018 for suggestions).

7. Summary

The starting point of this paper was a range of readings found with the Hebrew particle *bixlal* and its accented version *BIXLAL*, originally observed and discussed in Migron 2003 and in a number of works by Greenberg and Khrizman. Inspired by the intuitions in these works, we argued that (a) the unaccented *bixlal* is a member of the typology of *even*-like operators in Hebrew, along the unmarked particle *afilu*, and that (b) the range of readings found with *BIXLAL* results from the same *even*-like operation done over 'covert-based', namely degree-based and domain-based alternatives. We supported this analysis of *bixlal* and *BIXLAL,* and rejected an intensifier-based analysis, by pointing out the similar scopal behavior of these particles to *afilu* relative to surface negation, and the unique sensitivity of *BIXLAL* to standards of comparison, independently observed also for English *even* (Greenberg 2015, 2018). The behavior of *bixlal* and *BIXLAL* was then located in a wider set of observed facts concerning other overt and covert *even*-like and *only*-like particles which can be taken to operate over covert-based alternatives. We also discussed another non-standard type of alternatives operated over by some scalar particles, namely speech act alternatives.[13]

The emerging picture, then, points to the existence of a general parameter of variation for scalar, *even*-like and *only*-like particles, namely the type of alternatives that the particle can operate over (cf. Orenstein 2016, Greenberg and Orenstein 2016). A description of the different specifications of this parameter, and the manifestation of some of the scalar particles discussed above along these specifications, are schematically given in the following table:

The 'Type of alternatives' parameter for scalar (*even*-like and *only*-like) operators[14]		
	***Even*-like particles**	***Only*-like particles**
Can operate over standard 'Roothian' focus alternatives:	*even, afilu, bixlal, sogar, daze,* covert *E*	*only, just, merely, rak, be-sax ha-kol,* covert *O* (*exh*)
Can operate over 'covert-based' (e.g. degree-based and domain-based) alternatives:	*bhii, BIXLAL, voobšče*, *überhaupt,* covert *E*	*be-sax ha-kol, STAM,* covert *O* (*exh*)
Can operate over 'Speech act' alternatives (e.g. questions, denials, explanations)	*even, überhaupt, bixlal, voobšče*	*just, only, rak*

[13] Cf. Wiagand 2016, who takes the operation over speech act alternatives to be a special case of operation over 'covert-based' alternatives (which, following the terminology of Greenberg 2014, she calls 'internal' alternatives).

[14] Cf. Liu 2016, who considers a 'type of alternatives' parameter as well, for Chinese *even*-like and *only*-like particles. Liu's parameter, however, seems to me more similar to the 'type of scale' parameter, discussed in Coppock and Beaver 2014, Orenstein and Greenberg, 2014, Orenstein 2016, Greenberg and Orenstein 2016.

We hope that future research will contribute to the understanding of this picture, by examining the variation of additional scalar particles along this 'type of alternative', parameter both within and across languages, by refining the theoretical tools used to capture this parameter, and by examining the interaction of this parameter with other more well studied parameters along which *even*-like and *only*-like operators can vary.

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Two strategies of reopening QUDs — evidence from German *auch* & *noch*[1]

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Abstract. This paper argues for a domain restriction account for *wh*-words in questions using *resource situations*, in parallel with the domain restriction of quantifiers proposed in Kratzer (2011). It is argued that under a situation semantic account assuming resource situations, the different behaviour of additive particles can be explained: Under a *question under discussion* account, additive particles like *too* and *also* are used when a (possibly covert) question is 'reopened' in order to add a further true answer (Beaver and Clark 2008, i.a.). This paper suggests that there are two ways in which a question can be re-addressed: it can either be reopened with (i) a different resource situation or (ii) with a different topic situation. This can explain the different behaviour of the additive particles *auch* and *noch* in German.

Keywords: situation semantics, questions, additive particles

1. Introduction

The domain of *wh*-elements is contextually restricted, just like the domain of quantifiers: While in (2), there may have been many people at the party, but nobody relevant to the speaker/hearer, the question in (1) also only asks for party-goers relevant to the person posing the question.

(1) Who came to the party?

(2) Nobody came to the party.

Kratzer (2011) presents a situation-semantic account of quantifier restriction according to which a subsituation of the topic situation (= the situation that the utterance is about) is responsible for the restriction. This paper proposes that the same is the case for *wh*-questions like (1): the restriction of alternatives inherent in these questions is argued to come about via resource situations. The situation semantic background for this paper will be provided in section 2.

It is also argued that under a QUD account of additive particles, the behaviour of the German particles *auch* (= "also, too") and *noch* (= "still", "in addition") provides evidence for such a treatment of *wh*-questions: First, *noch* is most felicitous with an overt topic situation shifter (e.g. *dann* 'then') in declarative utterances. Second, *noch* is the preferred additive particle in questions, whereas *auch* seems to indicate that the speaker knows the answer to the question (Umbach, 2012). Third, in contrast to *auch*, which requires the focus of the host sentence to be distinct from that of the antecedent, *noch* imposes no such distinctness requirement. It is argued here that these differences can be accounted for under an analysis that assumes that both *auch* and *noch* indicate that a previous question is reopened, but whereas *auch* indicates reopening of the question with respect to a new resource situation, *noch* indicates reopening of the question with respect to a new topic situation. The background assumptions concerning additive particles, the German data, the analysis and a comparison with earlier analyses are presented in section 3.

[1] I would like to thank the audiences at Sinn und Bedeutung and at the ESSLLI 2016 workshop "Formal, Probabilistic and Typological Approaches to Discourse Particles and Modal Adverbs" (where I presented a partly overlapping talk on the typology of additive particles) for their feedback.

2. Situations

2.1. The topic situation

In a situation semantic account, propositions are functions from situations (i.e. parts of worlds) to truth values. This means that the truth of a declarative utterance is evaluated with respect to the situation that it is about, its *topic situation* (Kratzer, 2011). Kratzer illustrates this using the example in (3) (from Barwise and Etchemendy, 1987: 122): Here, '*Claire has the three of clubs*' is intuitively false, even though it is true in the evaluation world that Claire has the three of clubs. This intuition can be captured by assuming that this sentence is evaluated with respect to a subsituation of the evaluation world, a subsituation which is part of Game 1.

(3) (Emily is playing a card game (Game 1), and somewhere else, Claire is playing cards (Game 2). Both have the three of clubs.)
Someone, watching game 1, mistakes Emily for Claire & says:
Claire has the three of clubs.

The topic time (Klein, 1994), the interval about which the utterance makes a claim, temporally delimits the topic situation (Kratzer, 2011: §3). Temporal or locative adverbials provide further information about the topic situation (Klein, 2008: 289).

According to Kratzer (2011), the topic situation of a sentence can be derived from its *question under discussion* (QUD) (Roberts, 1998, 2012). In a QUD account, every declarative utterance is assumed to be an answer to an (often implicit) assumed hearer-question, the current question under discussion. In the absence of an explicit QUD, the focus/background division of the utterance indicates which implicit QUD the speaker attributes to the addressee at this moment in discourse. For example, an utterance with so-called *broad* focus, in which the whole sentence is in focus, is assumed to answer a very general question, e.g. *What happened?* (4),[2] while an utterance with narrow focus, in which a subconstituent of the sentence is in focus, is assumed to answer a question which asks for the constituent in focus, e.g. (5). The topic situation of the answer is the same as that of its question, e.g. (a subsituation of) a specific party in (4) or (5).

(4) (What happened?)
Amy and Ben danced.

(5) (Who danced?)
AMY AND BEN danced.

The idea of implicit QUDs is used to model the idea each declarative utterance is believed, by the speaker, to address the currently most relevant lack of information that the hearer has.

The QUD account also accounts for discourse coherence, by proposing a hierarchy of questions (Roberts, 2012). Here, the notational convention used in Büring (2003) to display this hierarchy as a *discourse tree* is adopted, e.g. (6). The dominating nodes are superquestions, the daughter nodes subquestions, and sister nodes are in temporal order, such that questions further to the right are asked later. The current question under discussion is lowest in the tree.

[2] In the examples, SMALL CAPS are used to indicate stress (where relevant), **bold font** and *italics* are used for highlighting the important parts of the example. # is used for infelicity, ?? and ? for marginal felicity.

(6)

Q1: What is the way things are?

Q2: What is the way things were since we last met? ...

Q3: What happened at the dinner last Sunday? ...

CQ: What did Yvonne eat? ...

A: Yvonne ate pizza

The topmost question “*What is the way things are*” is about the actual world w_0, to completely answer it would mean to know everything about our actual world, i.e. to be able to identify which world in context set is the actual world (Roberts, 2012: 5). Since this is impossible to answer in one sentence (if at all), this question is recursively split up into subquestions. Any superquestion entails its subquestions in the sense of Groenendijk and Stokhof (1984: 16): every complete answer to the superquestion also answers the subquestions (Roberts, 2012: 7). For example, a full answer to Q3 in (6), listing all that happened at the dinner, would also answer the current question *What did Yvonne eat?*. According to Schwarz (2009: 166), there is also a relation between the topic situations of the questions in the QUD hierarchy: each subquestion is about part of the situation asked about in its superquestion. For example, the situation of Yvonne eating something asked about in the current question is a subsituation of the dinner-last-Saturday-situation asked about in its superquestion Q3.

Following Schwarz (2009: 93–94), the topic situation is represented as a free situation pronoun (7), which is an argument to a topic operator (8). Applying this topic operator to a proposition and a topic situation yields the set of all counterparts (‘$\approx$’ is the counterpart relation) of the topic situation in which the proposition is true, see (9) for an example. Thereby, counterparts of the topic situation are situations in other worlds which in all relevant respects are exactly like the topic situation.

(7)

s_2

topic Yvonne ate pizza

(8) $[\![\text{topic}]\!] = \lambda p.\lambda s'.\lambda s.\ s \approx s' \ \&\ p(s)$

(9) $[\![s_2 \text{ topic Yvonne ate pizza}]\!]^g$
$= \lambda s.\ s \approx g(2)\ \&$ Yvonne ate pizza in s

Since the topic situation pronoun is free, it receives a value from the context, namely the situation that its immediate QUD is about. This situation is salient since the QUD is salient.

2.2. The resource situation

As discussed in Kratzer (2011), there is evidence that for quantifier restriction, another situation is needed, the *resource situation*. For example, as shown in (10) (from Soames, 1986: 357), there are cases of restriction to a subset of the individuals present in the topic situation. The topic situation here contains the test persons in a sleep lab, as well as the research assistants. The quantifier *everyone*, however, is implicitly restricted to the test persons. This is seen as evidence that the restriction of quantifiers is not provided by the topic situation, but, in this case, by a subsituation of the topic situation.

(10) **Everyone** is asleep and being monitored by a research assistant. (Soames 1986)

Similarly, examples involving so-called incomplete definite descriptions such as (11) (from McCawley, 1979: 378) can be used to argue for the necessity of resource situations. Definite descriptions like *the dog* require the referent to be the unique salient dog. In the topic situation of (11), however, there are two dogs. The felicity of such examples can be explained under the assumption that the referent is presupposed to be the unique salient individual of this kind in the resource situation (Schwarz, 2009), which in this case might involve members of the household.

(11) (Context: the family dog got into a fight)
I'll have to see to it that **the dog** doesn't get near that dog again.

One main proposal of this paper is that *wh*-phrases are also restricted via resource situations. The individuals that can potentially replace the *wh*-phrase in the answer are said to be restricted, too. For example, in (12), in the same sleep lab situation, the possible answers can plausibly be argued to be restricted to those that involve test persons.

(12) Who is asleep and being monitored by a research assistant?

Additionally, in a question-answer sequence like (13), where the *wh*-phrase is replaced by a quantifier in the answer, the resource situation of the *wh*-element and the quantifier are arguably the same, again involving only the test persons.

(13) Q: Who is asleep and being monitored by a research assistant?
A: Everyone!

A question, in the QUD approach, denotes the set of its possible answers (14) (following Hamblin 1973). For example, the denotation of the question in (14) is a set of possible answers in which the *wh*-element is replaced by a relevant individual.[3] Thereby, the *wh*-phrase denotes a set of individuals. In (14), *who* the set of human individuals in the resource situation. The resource situation is represented as a situation pronoun, which is the first argument of *who*, cf. (15b), where the value for the free situation pronoun is provided by the assignment function g.

(14) [[who was asleep]]
= {Amy was asleep, Ben was asleep, Cem was asleep, Dana was asleep ...}

(15) a. $[\![\text{who}]\!] = \lambda s.\lambda x.$ x is a human in s
b. $[\![\text{who } s_1]\!]^g = \lambda x.$ x is a human in g(1)

The *wh*-phrase is combined with the predicate via pointwise functional application (e.g. Rooth

[3] It is debated whether plural individuals are possible alternatives for singular individuals, cf. Beaver and Clark (2008) for discussion.

1992, 1996). This is a process of combining two sets, by which every member of the first set is combined with every member of the second set by standard functional application. Thus (14) is derived as shown in (16), or more generally in (17).

(16) {Amy is asleep in g(2), Ben is asleep in g(2), Cem ...}

who — **was asleep in** $\mathbf{s_2}$

{Amy, Ben, Cem, ...} {λx. x is asleep in g(2)}

(17) [[who s_1 was asleep in s_2]]
= [[was asleep in s_2]] ([[who s_1]])
= {λs. s$\approx$g(2) & x was asleep in s | x is a human in g(1)}

To sum up, statements are made about a topic situation, and evaluated for truth or falsity with respect to this topic situation. The topic situation can be identified with the help of overt cues, e.g. tense, temporal or locative adverbials, but usually it is identified because it is inherited from the sentence's QUD, the (usually implicit) hearer-question that the sentence answers. Evidence from the restriction of quantifiers and definite determiners shows that in addition, a resource situation must be assumed. The following section will present evidence from the German additive particles *auch* and *noch* that both topic and resource situations play a role for additive particles.

3. Additive particles

Additive particles like English *also/too* do not contribute to the truth-conditional meaning of the sentence, they merely introduce a presupposition. They are focus-sensitive: the presupposition changes when the placement of the focus changes.

(18) John also introduced BILL to Sue.
PRESUPP: John introduced somebody else to Sue.

(19) John also introduced Bill to SUE.
PRESUPP: John introduced Bill to somebody else.

The presupposition of additive particles is different from those of many other presupposition triggers (e.g. *stop*) in that it needs to be salient, i.e. on the minds of the speaker and the addressee, rather than merely mutually known. For example, the utterance in (20), *Mary stopped smoking*, is possible without the information that Mary used to smoke being recently mentioned or otherwise salient. For the additive particle in (21), *Bill smokes, too*, to be felicitous, the information that somebody else smokes (e.g. *Mary smokes*) must be recently mentioned, or in the immediate non-linguistic context (e.g. the addressee might be smoking at the time of utterance). If it is merely mutually known that somebody else smokes, but not salient at this time in discourse, this is not enough to license the use of *too*. For this reason, the additive presupposition has been classified as anaphoric (Kripke 2009; Beaver and Zeevat 2007; Tonhauser et al. 2013, i.a.)

(20) Mary stopped smoking.
PRESUPP: Mary used to smoke
(doesn't have to be salient)

(21) Bill smokes, too.
PRESUPP: Somebody (e.g. Mary) smokes
(has to be salient!)

There are several different ways to model the anaphoricity of additive particles (e.g. Heim 1992; Geurts and van der Sandt 2004, cf. Ruys 2015 for a discussion). The approach adopted here is a QUD account of additive particles. Under this account, additive particles are anaphoric because they indicate that the current QUD is already partially answered in the recent context (Beaver and Clark, 2008; Jasinskaja and Zeevat, 2009). For example, in the case of (21), the relevant part of the QUD hierarchy would look like (22): the same question has been asked and answered before, and is reopened, thereby indicating that the previous answer (*Mary smokes*) was a partial answer, and providing a further partial answer (*Bill smokes*).

(22)
...
Who smokes? Who smokes?
MARY smokes BILL smokes, too

The complete answer (Mary and Bill smoke) must be stronger than either of the partial answers alone. For this reason, examples like (23), where one of the answers entails the other, are infelicitous (Kripke, 2009; Beaver and Clark, 2008).

(23) #Bill smokes, and Bill and Mary smoke, too.

This section introduced the general QUD account adopted in this paper. The following sections discuss the additive particles *auch* and *noch* in German. It will be argued that while both indicate that a QUD is reopened, *auch* indicates reopening with respect to the same topic situation (but a different resource situation), whereas *noch* indicates reopening with respect to a different topic situation.

3.1. German additive particles

In German, *auch* (='also', 'too') is the standard additive particle. Unstressed *auch* associates with focus (cf. e.g. Jacobs, 1983; König, 1991; Krifka, 1998: i.a.). Like other German focus-sensitive particles, *auch* prefers to be as close to the focus as possible (see Büring and Hartmann 2001's Closeness Principle), as shown in (24)–(25).

(24) Gestern hat Johann **auch** BILL Susi vorgestellt.
yesterday has Johann PRT Bill Susi introduced.
"Yesterday, Johann also introduced BILL to Susi."
PRESUPP: Johann introduced somebody else to Susi.

(25) Gestern hat Johann Bill **auch** SUSI vorgestellt.
yesterday has Johann Bill PRT Susi introduced.
"Yesterday, Johann also introduced Bill to SUSI."
PRESUPP: Johann introduced Bill to somebody else.

There is also a stressed variant of *auch*, which associates with preceding out-of-focus constituents (Krifka, 1998). For example, Krifka shows that AUCH can associate with the unstressable pronoun *es* (= 'it'), in contrast to *nur* (= 'only') and unstressed *auch*.

(26) *Es* gehört AUCH Peter.
it belongs.to also Peter
"It belongs to Peter, too."

(27) ??Nur/??auch *es* gehört Peter.
only also it belongs.to Peter
"Only/Also it belongs to Peter."

The corresponding examples with the stressable pronoun *das* (='that'), in contrast, are fine.

(28) *Das* gehört AUCH Peter.
that belongs.to also Peter
"That belongs to Peter, too."

(29) Nur/auch *das* gehört Peter.
only/also that belongs.to Peter
"Only/Also that belongs to Peter."

According to Krifka, AUCH associates with contrastive topics, i.e. topics marked with a certain accent (a "B accent", cf. Jackendoff 1972), indicating a QUD hierarchy in which sister questions about alternatives to the contrastive topic play a role (Büring, 2003: 520). For example, if *Fred ate the beans* is pronounced with a contrastive topic accent on *Fred* and a focus on *beans*, it indicates a QUD hierarchy such as (30), indicating a following sister question which also addresses the question who ate what.

(30) *Who* ate **what**?
What did *Fred* eat? **What** did *Mary* eat?
Fred ate **the beans** *Mary* ate **the eggplant**

When AUCH associates with a contrastive topic, it indicates a QUD strategy like (31), in which a preceding sister question was answered in the same way.

(31) *What* belongs to **who**?
Who does *the bag* belong to? **Who** does *the phone* belong to?
The bag belongs to **Peter** *The phone* belongs to **Peter**

The German particle *noch* ("still") also has an additive use (Umbach, 2012; Eckardt, 2007; Nederstigt, 2006), cf. (32) (from Umbach 2012: 1844).

(32) Otto hat **auch/noch** einen SCHNAPS getrunken.
Otto has PRT a Schnaps drunk.
"Otto also drank a SCHNAPS."
(PRESUPP: Otto drank something else (e.g. a beer))

It however differs from better-studied additive particles like *also/too* (E.)/*auch* (G.) in interesting ways. The following section will describe some of these differences. The main claim will be that both additive particles indicate that a QUD is reopened. *Noch* indicates that it is reopened with respect to a new topic situation, whereas *auch* indicates that new alternatives are taken into consideration, i.e. that the resource situation is changed.

3.2. Differences between 'auch' and 'noch'

This section describes three important differences between *auch* and the additive use of *noch*: First, that *noch* is most felicitous with overt topic situation shifters, second, that it is the 'neutral' additive particle in questions, whereas *auch* leads to 'showmaster questions' and third, that it allows for the reopened QUD to be answered in the same way.

Overt topic situation shifters In contrast to *auch*, additive *noch* is not entirely felicitous in standard additive contexts, where the antecedent (e.g. *Otto had a beer*) is immediately followed by a parallel utterance '*He also had a schnaps*', cf. (33).

(33) Otto had a beer.
Er hat **auch**/??**noch** einen SCHNAPS getrunken
he has PRT a schnaps drunk
(intended:) "He also had a schnaps."

Instead, *noch* is most felicitous if there is an overt indication of a shift in topic situation (e.g. with *dann* ('then'), *ansonsten/sonst* ('otherwise')), see (34).

(34) Otto had a beer.
Dann hat er **noch** einen SCHNAPS getrunken.
then has he PRT a schnaps drunk
"And he also drank a schnaps."

This is also discussed in Umbach (2012: 1851), who proposes that in such sentences, "*dann* indicates that the two answer events combined by *dann* do not overlap", and provides example (35) as evidence. Here, according to Umbach, the thunderstorm (without rain) and the rain count as two separate, non-overlapping, events.

(35) There was a thunderstorm
Dann hat es **noch** GEREGNET.
then has it PRT rained
"It rained in addition."

The reverse, i.e. that *auch* is most felicitous if there is no shift in topic situation, can be observed in cases of accommodation. For example, in (36)–(37), there is an overt indication of a new topic situation (*the next year*) in the host sentence of the additive particle, making it an utterance about a different topic situation than the overtly presented antecedent. In the case of *noch* in (36), this is not problematic: *noch* links these two utterances without any need for accommodation.

(36) In 2014, Max visited his parents for Christmas.
Das Jahr danach hat er **noch** die Eltern seiner FREUNDIN besucht
the year after has he PRT the parents of.his girlfriend visited
"In addition, the next year, he visited the parents of his girlfriend."
→ He visited his parents in 2014 & his girlfriend's parents in 2015

In the case of *auch* in (37), however, the prominent reading is that Max visited his and his girlfriend's parents the next year, i.e. an antecedent about the same topic situation (*the next year*) is accommodated.[4]

(37) In 2014, Max visited his parents for Christmas.
Das Jahr danach hat er **auch** die Eltern seiner FREUNDIN besucht.
the year after has he PRT the parents of.his girlfriend visited
"The next year, he visited the parents of his girlfriend too."
→ He visited his parents in 2014 & **his and his girlfriend's parents in 2015**

Example (38) is a similar example: this is a variation of Umbach's example (35), replacing *noch* by *auch*. Again, as in (37), the new topic situation — introduced by *dann* — is understood to involve a thunderstorm in addition to rain.

(38) There was a thunderstorm
Dann hat es **auch** GEREGNET.
then has it PRT rained
"Then it rained, too."

Questions In questions, *noch* is most felicitous, whereas *auch* indicates that the questioner knows that a further answer is true, i.e. the *auch*-question is a kind of 'showmaster question', according to Umbach (2012). For example, Umbach notes that in a context like (39), only Lisa's aunt, who knows everything that happened at the zoo, can ask the *auch*-question in (39a). Lisa's mother, who didn't accompany them to the zoo and doesn't know what happened there, can only ask the *noch*-question in (39b). The *auch* question is thus asked by a person who already has a particular answer in mind, hence Umbach's term 'showmaster question'.

(39) (Little Lisa tells her mother what happened when she visited the zoo with Auntie.)
A: Und was ist im Zoo AUCH passiert?
and what is in.the zoo PRT happened
"What happened at the zoo, too?"

[4]This difference between *noch* and *auch* is very subtle, and is currently being experimentally tested.

M: Und was ist im Zoo NOCH passiert?
and what is in.the zoo PRT happened
"What else happened at the zoo?"

This is accounted for by the current approach as follows: in the showmaster question in (40a), Lisa's aunt reopens the same QUD with respect to a different resource situation, i.e. she indicates that in her first answer, Lisa has not taken all relevant alternatives into account. Reopening the QUD with respect to the same topic situation but a different resource situation, as in the case of *auch*, indicates that relevant alternatives were forgotten or ignored, whereas reopening the QUD with respect to a new topic situation, as in the case of *noch*, merely slightly shifts the topic of conversation, and is thus the 'neutral' variant in overt questions.

Stressed 'noch' When a QUD is reopened using *noch*, the same answer is available again. According to Umbach (2012), *noch* in (40) associates with a deaccented focused constituent, namely 'Schnaps'.

(40) Otto had a schnaps. And you won't believe it:
Er hat NOCH einen Schnaps getrunken.
he has PRT a schnaps drunk
"He had another schnaps." / "# He had a schnaps, too"

Example (41), in contrast, is odd, independent of the accenting pattern.

(41) Otto had a schnaps. And you won't believe it:
#Er hat *auch* einen Schnaps getrunken.
he has PRT a schnaps drunk
"# He had a schnaps, too"

This can be explained by the fact that, since the QUD (*What did Otto drink?*) is reopened with respect to a new topic situation in (40), the same answer (*Otto drank a schnaps*) will still be informative. In (41), in contrast, the QUD is reopened with respect to the same topic situation, thus only a different answer (e.g. *Otto drank a beer*) would be felicitous.[5]

To sum up, *auch* and *noch* differ first with respect to their occurrence with overt topic situation shifters, which is most felicitous with *noch*. Second, in questions, *noch* is the standard additive particle, while *auch* seems to indicate that the speaker knows the answer to the question. This was attributed to the resource situation-shifting nature of *auch*. Third, a *noch*-answer can be the same as its antecedent answer, while an *auch*-answer has to differ. This is due to the topic shift inherent with *noch*: it allows for the same alternatives to become available again.

[5]There seems to be a connection between stressed *noch* and additive or incremental *more* (Greenberg, 2010, 2012), which Greenberg analyses as indicating further development of a previous eventuality.

(i) Otto had one more schnaps.

This is an interesting account, which would also complement nicely an account of *noch* along the lines of Ippolito (2007), but since the *noch* and *more* data differ in some respects, a discussion of this is left for future work.

3.3. Analysis of 'auch' and 'noch'

Unstressed *auch* indicates that there is a previous answer to the same QUD, but with a more restricted set of alternatives. The current QUD extends this set to include previously neglected relevant alternatives. For example, the answerer in (42) might have thought of the alternatives {a schnaps, a glass of wine, a glass of cider} in the first answer, but forgotten the beer. By uttering an *auch*-sentence, she thus repairs this by considering a new domain of alternatives which now includes the beer. The question is thus reopened with respect to a new resource situation, as represented in the discourse tree in (42).

(42)

What **in** $\mathbf{s}_{r1}$ did Otto drink in s_t? What **in** $\mathbf{s}_{r2}$ did Otto drink in s_t?

Otto drank a schnaps$_F$ in s_t Otto drank 'auch' a beer$_F$ in s_t

This is essentially the analysis given in Umbach (2012: 1860–1861) for unstressed *auch*, who proposes the term *extension question* for questions with shifted resource situations, cf. Umbach's definitions in (43)–(44).

(43) unstressed *auch* in answers addresses an extension question;
unstressed *auch* in questions indicates that the question is an extension question.

(44) A question Q=$\langle$B, D$\rangle$ is an extension question with respect to a preceding question Q'=$\langle$B', D'$\rangle$ iff (i) B=B', (ii) D∩D' = ∅, (iii) D∪D' is a superordinate domain.

In contrast, *noch* indicates that there is a previous answer to a parallel QUD about a different topic situation in the discourse context, cf. (45).

(45)

What did Otto drink **in** $\mathbf{s}_{t1}$? What did Otto drink **in** $\mathbf{s}_{t2}$?

Otto drank a schnaps$_F$ in s_{t1} Otto drank 'noch' a schnaps$_F$ in s_{t2}

This requirement that the preceding QUD be about a different topic situation can be represented as in (46)–(47). Thereby, *noch* does not indicate anything about the domain of alternatives, i.e. it does not require the domain to be different or the same in the two questions.

(46) *noch* in answers addresses a shifted question ;
noch in questions indicates that the question is shifted.

(47) A question Q=$\langle$B, D$\rangle$ about S is a shifted question with respect to a preceding question Q'=$\langle$B', D'$\rangle$ about S' iff (i) B=B', (ii) S≠S'

3.3.1. Combining ‘auch’ and ‘noch’

Since it is possible to combine *auch* and *noch*, the account for *auch* does not require the topic situation to remain the same, and the account for *noch* does not require the resource situation to remain the same. The prediction thus is that both situations would be different from those of the antecedent, cf. (48), leading to a few predictions, briefly discussed below.

(48)

What **in** $\mathbf{s}_{r1}$ did Otto drink **in** $\mathbf{s}_{t1}$? What **in** $\mathbf{s}_{r2}$ did Otto drink **in** $\mathbf{s}_{t2}$?

Otto drank a schnaps$_F$ in s_{t1} Otto drank ‘auch’ a beer$_F$ in s_{t2}

Prediction I: *auch noch* should allow for a topic situation shift (without accommodation) (49), like *noch*.

(49) In 2014, Max visited his parents for Christmas.
Das Jahr danach hat er **auch noch** die Eltern seiner FREUNDIN besucht.
the year after has he PRT PRT the parents of.his girlfriend visited
“The next year, in addition, he visited the parents of his girlfriend.”
→ He visited his parents in 2014 & his girlfriend’s parents in 2015

Prediction II: *auch noch* should indicate a shift of resource situation, and thus lead to show-master questions (like *auch*), which seems to be the case: the question in (50) is much more natural when it is posed by the aunt than when it is posed by the mother.

(50) (Little Lisa tells her mother what happened when she visited the zoo with Auntie.)
Auntie: Und was ist im Zoo auch noch passiert?
and what is in.the zoo PRT PRT happened
“What else happened at the zoo, too?”

Prediction III: *auch noch* should indicate a shift of resource situation, and thus disallow giving the same answer again (like *auch*). This is in fact the case: (51) is infelicitous, unless *auch* is understood to associate with the full VP in its scope, leading to the presupposition that he did something else apart from drinking another schnaps. This is the reading obtained when *noch* is accented, and there is a slight pause between *auch* and *noch*.

(51) Otto had a schnaps. And you won’t believe it:
#Er hat **auch noch** einen Schnaps getrunken.
he has PRT PRT a schnaps drunk
(intended:) “He had another schnaps.”

3.3.2. Comparison with other approaches

Dimroth 2002 The proposal presented here for *noch* is reminiscent of a proposal in Dimroth (2002) for stressed NOCH as in (52). Dimroth proposes that stressed NOCH associates with the topic time, just like stressed AUCH associates with a (contrastive) topic.

(52) Otto had a schnaps. And you won't believe it:
Er hat NOCH einen Schnaps getrunken.
he has PRT a schnaps drunk
"He had another schnaps."

A problem with this, which has already been voiced in Nederstigt (2006), is that if *noch* could associate with something topical and thus out-of-focus, it should be able to stand alone, as stressed AUCH can, cf. (53).

(53) At 10p.m., Otto had a schnaps. And at 11 p.m.?
AUCH./#NOCH.

The other accounts known to me (e.g. Nederstigt, 2006; Eckardt, 2007; Umbach, 2012) all assume that *noch*/NOCH associates with focus in all examples.

Eckardt 2007: Eckardt (2007) proposes that (unstressed) *noch* can be used to reopen a QUD if the previous answers are positive. According to her, the QUD is reopened as a sub-QUD, involving a subset of its super-QUD's domain, i.e. the discourse tree would look as in (54). *Noch* can also be used in such a reopened QUD, if it is overt.

(54) Who (of A,B and C) can swim?
Ali can swim Who (of B and C) can swim?
Ben can swim

This is used to explain the observation that *noch* is often used for the last element in a list of positive answers, cf. (A) in (55).

(55) Q: Who (of A, B and C) can swim?
A: ALI kann schwimmen, und BEN kann **noch** schwimmen, aber CEM *kann nicht schwimmen*.
"ALI can swim, and BEN can swim, but CEM can't swim"

This account would predict that the answer in (56) is bad, a prediction that I don't share.[6]

[6]Note however that judgments on these particles are notoriously difficult.

(56) Q: Who (of A, B and C) can swim?
A: (#) ALI kann schwimmen, BEN *kann nicht schwimmen*, aber CEM kann **noch** schwimmen.
"ALI can swim, BEN can't swim, but CEM can swim"

Umbach (2012), in her discussion of this account, notes that it is problematic because it cannot account for all of the differences between *noch* and *auch*. For example in *noch*-questions, the domain of alternatives is clearly extended.

Umbach 2012 According to Umbach's own proposal, *noch* and unstressed *auch* both reopen a QUD with an extended domain (57).

(57)

Who (of {A,B}) can swim? Who (of {C,D}) can swim?

Ali can swim Cem can swim

The main difference between the two is that the alternatives in the case of *noch* are in a temporal order, an order of (expected) time of mentioning. This temporal order allows to distinguish string-identical alternatives (*schnaps*$_1$, *schnaps*$_2$) in the case of stressed NOCH, which can not be distinguished in the case of *auch*.

For stressed AUCH, Umbach (2012) proposes that it reopens a QUD with a subset of the original domain, as Eckard had proposed for *noch*, cf. (58).

(58)

Who (of {A,B,C}) can swim? Who (of {B,C}) can swim?

Ali can swim Ben can swim

She analyses *auch* in *wh*-questions as an instance of stressed AUCH, with the *wh*-element as a topic. This accounts for 'showmaster questions':

(59) Wer kann AUCH schwimmen? "Who can swim, too?"

The current account rejects the idea that the exact same QUD (about the same topic situation) can be reopened with respect to a subset of the same domain (as proposed by Eckardt for *noch* and Umbach for AUCH). Implicit QUDs essentially reflect **speaker assumptions** about the alternatives relevant for the hearer. Thus to remind the speaker that she forgot a relevant alternative means to extend the domain of alternatives.

In addition, an ordering of alternatives by order of mentioning is not adopted in the current account, since additive particles, being anaphoric, always involve another answer being mentioned earlier than the current one. It is therefore hard to imagine a context in which *auch* would be licensed but *noch* wouldn't under this account. A final difference between the current account and Umbach's is that the *wh*-element in AUCH-questions is not assumed to be a topic.

4. Summary and outlook

The behaviour of the German additive particles *auch* and *noch* provides evidence for resource situations in *wh*-questions: *auch* indicates that a QUD about the same topic situation is reopened, with a different resource situation, i.e. considering further alternatives, whereas *noch* indicates reopening of a question, but about a different topic situation.

There are several questions remaining for future discussion. First, many examples involving *noch* are very subtle. It is thus of vital importance to test the phenomena discussed in these papers with a large group of native speakers. This will be done in future work. Second, it is not entirely clear how the account for additive *noch* discussed in this paper relates to the other uses of *noch* as *still*, e.g. the temporal use in (60), the related locative use in (61), the marginality use in (62), and the comparative use in (63), i.a. (e.g. König, 1977; Löbner, 1989; Krifka, 2000; Umbach, 2009).

(60) TEMPORAL/ASPECTUAL
Es regnet noch.
It rains still
"It is still raining."
PRESUPPOSITION: It was raining earlier
CONVERSATIONAL IMPLICATURE: It will stop raining soon

(61) LOCATIVE/MARGINALITY
Osnabrück liegt noch in Niedersachsen.
Osnabrück lies still in Niedersachsen
"Osnabrück is still in Lower Saxony."

(62) MARGINALITY
Paul ist noch gemässigt. (Peter ist schon radikal)
Paul is still moderate Peter is already radical
"Paul is still moderate. (Peter is already radical)"

(63) COMPARATIVE
Berta ist noch größer als Adam.
Berta is still taller than Adam
"Berta is even taller than Adam."

While the topic situation in (60) (e.g. "now") is certainly different from that of the earlier event, the current analysis neither captures the presupposition that the two events are of the same kind ("rain") nor the implicature that later, there will be no event of this kind. The analysis presented here can thus not easily be applied to cases like (60) and other, e.g. non-temporal, *noch* examples.

In contrast, it is a great advantage of the accounts of Eckardt (2007) and Umbach (2012) that they do intuitively relate to previous accounts of the temporal reading in (60). For example, Eckardt's proposal that *noch* adds a positive answer to a QUD after a preceding stretch of discourse containing positive answers to this QUD is related to Löbner (1989)'s analysis of temporal *noch*, which assumes that (60) adds a current period of rain, after a presupposed preceding period of rain. Umbach, in contrast, relates her proposal to Krifka (2000)'s account, in which *noch* imposes an order on focus alternatives (e.g. *it is raining*, *it isn't raining* in (60)) on a temporal scale, such that the alternative *it is raining* precedes the alternative *it isn't raining*. Umbach assumes that the different alternatives, i.e. the current utterance and its antecedent, are also ordered on a temporal scale, but not concerning the event time of the mentioned events but concerning the time of mention in discourse: the *noch*-sentence presupposes an ordering such that there is an alternative that is lower on the scale, i.e. was mentioned earlier.

Therefore, an important aspect of future work on this particle will be to find a unified account for the additive use described here and temporal and other uses of *noch*.

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Internal and external readings of *same*: Evidence for a uniform account[1]

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Abstract. *Same* is an anaphoric element that performs a comparison, which can either be external or internal to a sentence. Hardt and Mikkelsen (2015) show that *same*, unlike other anaphoric expressions, imposes a parallelism constraint, and they present three types of examples showing that *same* is infelicitous in the absence of parallelism. Hardt and Mikkelsen propose an account that applies uniformly to internal and external readings; however, the evidence they present largely targets external readings – they don't offer empirical evidence that clearly supports the uniform approach. Furthermore, Barker (2007) argues that internal readings must be treated differently than external readings. In this paper, I show that the parallelism effects observed by Hardt and Mikkelsen in fact apply to internal readings as well. This provides support for a uniform treatment of internal and external readings of *same*. It also suggests that discourse relations, which typically apply to separate overt predications, also apply to the implicit predications that arise in distributional structures.

Keywords: same, anaphora, parallelism

1. Introduction

Same performs a comparison, which can either be external, as in (1), or internal, as in (2).

(1) John read *War and Peace*. Tom read the same book.

(2) Every boy read the same book.

In (1), the definite *the same book* must be identified with the antecedent NP, *War and Peace*. It would appear to impose a semantic identity condition on an antecedent expression in surrounding discourse. In this way *same* is like pronouns, definites, and ellipsis, all of which require identity with an antecedent. In (2), the internal reading is licensed, or controlled, by a quantified NP, *every boy*. Since Carlson (1987), it has been recognized that the controller need not be a NP, but can be a variety of syntactic categories. Barker (2007) captures this diversity of controllers with an account that only applies to internal readings. Hardt and Mikkelsen (2015), on the other hand, argue for treating internal and external readings in a uniform way, and they argue furthermore that *same* gives rise to a discourse parallelism requirement. They give three types of observations in support of this theory. But all three of these observations concern external readings, and not internal readings. Thus they don't provide concrete empirical support for their proposal that internal and external readings receive the same treatment.

In this paper, I present new arguments in favor of a uniform account of external and internal readings of *same*: I show that all three of Hardt and Mikkelsen's observations, distinct antecedent, parallel antecedent, and negated antecedent, apply to internal readings as well as external readings.

[1]Thanks to Line Mikkelsen for useful input.

2. Background

2.1. Internal readings

As pointed out by Carlson (1987), *same* can give rise to internal readings. He points out that this requires a distributive element, a quantifier or coordination. We term this element the controller (shown in **bold**). So in (3), the controller is the QP *Every boy*, while in (4) it is the conjoined NP *John and Sam*. As (5) and (6) illustrate, the controller need not be a nominal category – here we observe a conjoined V and a conjoined PP.

(3) **Every boy** read the same book.

(4) **John and Sam** read the same book.

(5) Sam **praised and criticized** the same book.

(6) Sam assigned the same book **in March and in April**

As Carlson puts it, in the internal reading, the sentence "provides its own context" for the interpretation of *same*. Any conjoined constituent can function as controller, it would appear, as long as it is interpreted distributively. Heim (1985) also acknowledges the diversity of potential controllers. This is dealt with explicitly by Barker (2007)[p. 25], who introduces a structural postulate which makes it possible to λ abstract over any distinguished element. In what follows, I will simply assume that a controller can be any syntactic object that can participate in coordination.

2.2. External readings

While internal readings "provide their own context", one can observe analogous readings for *same* where surrounding discourse provides the context, as in (7), which is directly analogous to (4) above.

(7) **John** read *War and Peace*. **Sam** read the same book.

We can think of *John* and *Sam* as controllers in (7). Note that, just like internal readings, external readings exhibit a diversity of controllers – verbs in (8) and prepositional phrases in (9).

(8) John **praised** *War and Peace*. Then he **criticized** the same book.

(9) John assigned *War and Peace* **in March**. He assigned the same book **in April**.

Much previous literature (Brasoveanu (2011); Heim (1985)) emphasizes the evident analogy between internal and external readings. But Barker (2007) argues that his proposed account should only apply to internal readings, and while Hardt and Mikkelsen (2015) follow most previous literature in seeking a uniform account, their empirical arguments, based on parallelism, don't seem to naturally apply to internal readings. Thus, the question of a uniform treatment of internal and external readings is left rather open. In what follows, I will show that Hardt and Mikkelsen's parallelism arguments can also be made with respect to internal readings. The key to doing this is to look at examples where the controllers are verbal rather than nominal categories.

3. Hardt and Mikkelsen's proposal

Hardt and Mikkelsen take as their starting point a double indexing approach for *same*, as proposed by Brasoveanu (2011). This is a natural reflection of the fact that *same* compares two expressions: a local containing expression and its antecedent.

3.1. Brasoveanu's account

I illustrate the account of Brasoveanu (2011) with respect to (10).

(10) Every^{u_0} boy read the^{u_1} same$^{2}_{u_1}$ book.

Intuitively, the interpretation is this:

(11) for every pair of boys b_1 and b_2 and pair of books k_1 and k_2 such that b_1 read k_1 and b_2 read k_2, $k_1 = k_2$

To capture this, Brasoveanu defines a distribution operator that distributes over pairs of individuals, and then gives *same* and *different* the ability to access such pairs. Brasoveanu gives the following meaning for same:

(12) $\text{same}^{m}_{u_n} \rightsquigarrow \lambda P_{et}.\lambda v_e.P(v);*(\underline{P(u_{n+m})};[\mathbf{identical}\{u_{n+m},u_n\}])$

On Brasoveanu's account *same* compares a containing NP with an antecedent NP. The challenge for internal readings is that there is no explicit antecedent for *same*. To address this, Brasoveanu posits a distribution operator which allows comparison of individuals within the domain of quantification.

To understand how this works, consider the drs for (10):

(13) $\mathbf{max}^{u_0}([\mathbf{atoms\text{-}only}\{u_0\},boy\{u_0\}]);$
$\mathbf{dist}_{u_0}([u_1|\mathbf{atoms\text{-}only}\{u_1\}],\mathbf{singleton}\{u_1\},book\{u_1\};$
$*(\underline{(book(u_{1+2})};[\mathbf{identical}\{u_{1+2},u_1\}]);[read\{u_0,u_1\}]))$

The contribution of *every boy* is the maximal set of boys, while the *dist* operator tests each element of that set to see that it satisfies the nuclear scope. In doing this *dist* in fact examines all pairs of elements, call them boy_1 and boy_2, and checks each element to see that it satisfies the nuclear scope, which itself involves an update, namely a book associated with each boy – these boy-book pairs are termed *stacks*. In this example each stack has length 2; in general they can be of any length. Thus *dist* checks every pair of stacks, s_1 and s_2, to ensure that both s_1 and s_2 satisfy the nuclear scope. These expressions make use of the stack-concatenation operator, $*$, which examines its two input stacks, and concatenates them. The concatenated stack can then be used to compare two analogous individuals, using the offset, which is the length of the input stacks.

$$\begin{array}{cc} u_0 & u_1 \\ \hline \multicolumn{1}{|c|}{\text{boy1}} & \multicolumn{1}{c|}{\text{book1}} \\ \hline \end{array} \; * \; \begin{array}{cc} u_0 & u_1 \\ \hline \multicolumn{1}{|c|}{\text{boy2}} & \multicolumn{1}{c|}{\text{book2}} \\ \hline \end{array} \; = \; \begin{array}{cccc} u_0 & u_1 & u_2 & u_3 \\ \hline \multicolumn{1}{|c|}{\text{boy1}} & \multicolumn{1}{c|}{\text{book1}} & \multicolumn{1}{c|}{\text{boy2}} & \multicolumn{1}{c|}{\text{book2}} \\ \hline \end{array}$$

The resulting stack makes available two discourse referents, u_1 and u_3; in the drs above, the **identical** condition is placed on these two discourse references, as desired. The distribution operator ensures that all possible pairs of stacks will be compared, which in this case means that all pairs of boys read the identical book.

Hardt and Mikkelsen take issue with Brasoveanu, in that they claim that *same* is different, in that it indexes eventualities, unlike *different* and other anaphoric expressions.

3.2. Parallelism

The main claim of Hardt and Mikkelsen (2015) is that *same* requires parallelism. More specifically, the clause containing *same* and the antecedent clause must be related by Parallel, as defined here, folllowing Kehler (2002):

(14) Parallel: Infer $P(a_1, a_2, \ldots)$ from the assertion of $S1$ and $P(b_1, b_2, \ldots)$ from the assertion of $S2$, for a (non-trivial) common P and similar a_i and b_i.

Parallel requires a common relation P that subsumes the relation of both $S1$ and $S2$, as well as similar parallel elements. To satisfy Parallel, two eventualities must contain similar predicates applied to similar arguments. Two predicates count as similar if they both entail a non-trivial common relation. The arguments are similar to the extent that similar predicates apply to them. An intuitive way of computing this can be found in accounts such as Asher (1993) and Prüst et al. (1994), where parallelism is thought of as a kind of most specific unifier, which captures the semantic commonality between the two eventualities.

3.3. Semantic representation

Hardt and Mikkelsen (2015) follow Brasoveanu in giving a uniform treatment of *same* in this way, whether it appears with internal or external readings. However, recall that Hardt and Mikkelsen define *same* somewhat differently, so that, on their account, a Parallel condition is placed on the containing and antecedent eventualities.

The meaning for *same* for Hardt and Mikkelsen builds on that given in Brasoveanu (2011), with two key modifications: first, *same* compares eventualities rather than individuals. Second, the comparison is the discourse condition Parallel, rather than a simple identity.

This is the meaning for *same* proposed by Hardt and Mikkelsen (2015):

$\text{same}^{m}_{e_n} \rightsquigarrow \lambda P_{et}.\lambda v_e.P(v); *[\textbf{parallel}\{e_{n+m}, e_n\}]$

The subscript e_n indexes *same* to the containing eventuality, and the antecedent eventuality is determined by adding the offset m to n. The discourse condition Parallel is applied to these two eventualities.

We return now to (10), which receives the following representation:

(15) [Every^{u_0} boy read the^{u_1} same$^{3}_{e_2}$ book.]^{e_2}

With this indexing, the subscript for *same*, e_2, indexes the containing S, rather than the containing NP as in Brasoveanu's system. Other than that, the analysis proceeds in exactly the same way; the superscript on *same* is the offset, which is the size of the stack. Then, by using the *stack concatenation* operator $*$ below, the drs allows *same* to impose Parallel on two instantiations of the eventuality, $[read\{u_0, u_1\}]$.

(16) $\textbf{max}^{u_0}([\textbf{atoms-only}\{u_0\}, boy\{u_0\}]);$
$\textbf{dist}_{u_0}([u_1, e_2|\textbf{atoms-only}\{u_1\}], \textbf{singleton}\{u_1\}, book\{u_1\}), e_2 : read\{u_0, u_1\};$
$*[\textbf{parallel}\{e_{2+3}, e_2\}])$

u_0	u_1	e_2
boy1	book1	read(boy1, book1)

$*$

u_0	u_1	e_2
boy2	book2	read(boy2, book2)

=

u_0	u_1	e_2	u_3	u_4	e_5
boy1	book1	read(boy1, book1)	boy2	book2	read(boy2, book2)

Hardt and Mikkelsen's meaning for *same* can be applied for internal readings just as it is applied for external readings. However, the imposition of Parallel for internal readings would appear to be vacuous – as Hardt and Mikkelsen, say, for internal readings "it is somewhat difficult to discern the interpretive effect of same" (p 25). And indeed it is unusual to impose a discourse condition on the implicit predications that arise from distributive structure in this way. However, as we will see, there are in fact clear effects of parallelism on these internal readings.

4. Hardt and Mikkelsen's observations – external readings

Hardt and Mikkelsen (2015) present a series of contrasts that distinguish *same* from *different*, as well as other anaphoric forms. In each case *same* is ruled out where *different* and other anaphoric forms are allowed.

Distinct antecedent

The following example is originally due to Hardt et al. (2012), who observe that it is most naturally read as describing a single fish-catching event, and on that reading, *same* is infelicitous, while other forms are acceptable.

(17) a. John caught a big fish, and
b. he caught it/*the same fish without any fishing equipment.

Hardt et al. (2012) observe that *same* requires that the antecedent and containing clause must be distinct events. Hardt and Mikkelsen (2015) argue that this is a consequence of their parallelism constraint: Parallel is not satisfied because the containing clause, (17b), has a manner modifier, *without any fishing equipment*, which lacks a corresponding parallel element in the antecedent clause, (17a). Moreover, no such parallel element can be inferred, without losing the single-event reading.

(18) [John^{u_1} caught a^{u_2} big fish]^{e_3},
a. and [he$_{u_1}$ caught it$_{u_2}$ without any fishing equipment]^{e_4}.
b. *and [he$_{u_1}$ caught the^{u_4} same$_{e_5}^{-1}$ fish without any fishing equipment]^{e_5}.

The following is the drs for the antecedent clause in (18):

(19) $[u_1, u_2, e_3 | u_1 = John, fish(u_2), big(u_2), e_3 : caught\{u_1, u_2\}]$

The following is the drs for the continuation in (18a), which is acceptable:

(20) $[e_5 | e_5 : caught\{u_1, u_2, without\text{-}equipment\}]$

(21) gives the drs for the infelicitous continuation with *same*:

(21) $[u_4, e_5 | fish(u_4), u_4 = u_2, e_5 : caught\{u_1, u_4, without\text{-}equipment\}]$;
$*[\mathbf{parallel}\{e_5, e_4\}]$

Here we can see that Parallel fails. We can see that e_5 is *caught(*u_1, u_4*, without-equipment)*, and e_4 is *caught(*u_1, u_4*)*. Thus Parallel fails because there are not similar parallel elements.

Negated antecedent

(22) John didn't read *War and Peace*.
a. He read a different book.
b. *Susan read the same book.
c. Susan read it.

According to Hardt and Mikkelsen (2015), a negated antecedent is ruled out for *same*, because the antecedent eventuality must be accessible, as defined in DRT (Kamp and Reyle (1993)). They argue that this shows that the effect is a consequence of the fact that *same* imposes the Parallel condition on the containing and the antecedent eventuality; if the antecedent eventuality is not accessible, the drs would be ill-formed.

Hardt and Mikkelsen provide the following indexing for (22):

(23) [**not** [John^{u_1} read *War and Peace*^{u_2}]^{e_3}].
  a. [He$_{u_1}$ read a^{u_4} different$^{-2}_{u_4}$ book]^{e_5}.
  b. *[Susan^{u_4} read the^{u_5} same$^{-3}_{e_6}$ book]^{e_6}.
  c. [Susan^{u_4} read it$_{u2}$]^{e_5}.

The following is the drs for the antecedent clause, (23).

(24) $[u_1, u_2 | u_1 = John, u_2 = war\text{-}and\text{-}peace, \mathbf{not}[e_3 | e_3 : read\{u_1, u_2\}]]$

The drefs u_1 and u_2 are introduced at the top level drs, because they represent names. However, the eventuality dref e_3 is introduced in the drs that is embedded under **not**. Because of this, e_3 is not accessible to subsequent discourse. (25) shows the drs for the continuation in (23a).

(25) $[u_4, e_5 | book\{u_4\}, e_5 : read\{u_1, u_4\}]; *(\underline{book(u_{4-2})}; [\mathbf{disjoint}\{u_4, u_2\}])$

Here, *different* simply compares the drefs u_4 and u_2. There is no accessibility problem, since u_2 is introduced by the name *War and Peace* and is therefore accessible at the top level drs.

The drs for (23b) is as follows:

(26) $[u_4, u_5, e_6 | u_4 = Susan, book\{u_5\}, u_5 = u_2, e_6 : read\{u_4, u_5\}];$
$*[\mathbf{parallel}\{e_6, e_3\}]$

The problem here is that *same* must compare two eventualities, e_6 and e_3, but since e_3 is embedded under negation, it is not accessible. Finally, the drs for the continuation with a pronoun in (23c) is as follows:

(27) $[u_4, e_5 | u_4 = Susan, e_5 : read\{u_4, u_2\}]$

It is clear that this is acceptable: the pronoun is simply co-indexed with the accessible antecedent, u_2.

Notice that on Brasoveanu's analysis, *same* would not be ruled out, since, like *different*, it merely requires an accessible NP antecedent, in this case *War and Peace*. Of course, it might appear that *War and Peace* is also inaccessible, since it is embedded within the negation. However, it is standard in DRT to treat proper names differently; they are normally accessible at the top level drs. See Kamp and Reyle (1993) for details.

Parallel antecedent

(28) John praised *War and Peace*.
  a. And Bill read it/*the same book.
  b. But Bill criticized the same book.

According to Hardt and Mikkelsen (2015) *same* is ruled out in (28a), because Parallel is not satisfied by the antecedent clause *John praised War and Peace*, because it is not possible to infer a common non-trivial P that subsumes *read* and *praised*. Compare (28a) to the felicitous (28b): here Parallel is satisfied because one can infer from the verbs *criticize* and *praise* a common non-trivial P, namely *evaluate*, with similar parallel elements <*John*, *Bill*> and <*War and Peace*, *the book*>.

This is illustrated here for one version of (28):

(29) [John^{u_1} praised *War and Peace*^{u_2}]^{e_3}.
  a. * And [Bill^{u_4} read the^{u_5} same$_{e_6}^{-3}$ book]^{e_6}
  b. But [Bill^{u_4} criticized the^{u_5} same$_{e_6}^{-3}$ book]^{e_6}

Here we translate (29a) into the following drs's:

$[u_1, u_2, e_3 | u_1 = John, u_2 = \textit{war-and-peace}, e_3 : praise\{u_1, u_2\}]$

$[u_4, u_5, e_6 | u_4 = Bill, book\{u_5\}, u_5 = u_2,$
$e_6 : read\{u_4, u_5\}]; *[\textbf{parallel}\{e_6, e_3\}]$

Observe that Parallel is imposed on eventualities e_6 (read(Bill, War and Peace)) and e_3 (praise(John, War and Peace)). As discussed above, Parallel fails here because the predicates *praise* and *read* do not entail a non-trivial common property.

5. New observations – internal readings

In this section, we show that all the observations offered by Hardt and Mikkelsen (2015) with respect to external readings in fact apply in a similar way to internal readings.

Distinct antecedent

The following example is due to Barker (2007):

(30) a. David hit and killed Goliath.
  b. David hit and killed the same man.

As Barker observes, with Goliath, there is an ambiguity – there could be two events, a hitting event and a killing event, or there could be one event in which the hitting of Goliath was the killing of Goliath. With *same*, this ambiguity goes away – the hitting and killing must be distinct events. This is in fact observed by Hardt and Mikkelsen (2015), who point out that their Parallel constraint requires that the two events it relates are distinct. This is in fact completely analogous to the distinct antecedent claim given above with respect to external readings.

Following Hardt and Mikkelsen, we assume that (30a) receives the following drs representation:

(31) $[v_0, v_1, v_2 | v_0 = \textbf{hit}, v_1 = \textbf{killed}, v_2 = v_0 \bigcup v_1];$
$\textbf{dist}_{v_2}([u_3, u_4, e_5 | john\{u_3\}, man\{u_4\}, e_5 : v_2\{u_3, u_4\};$
$*[\textbf{parallel}\{e_{5+4}, e_5\}])$

v_2	u_3	u_4	e_5
hit	john	man1	hit(john, man1)

$*$

v_2	u_3	u_4	e_5
killed	john	man2	killed(john, man2)

=

v_2	u_3	u_4	e_5	v_6	u_7	u_8	e_9
hit	john	man1	hit(john, man1)	killed	john	man2	killed(john, man2)

The condition **parallel** is applied to the two eventualities, e_5 and e_9. As discussed above, Hardt and Mikkelsen argue that the Parallel condition quite generally includes a requirement that the two eventualities are distinct. Since it is *same* that introduces the parallelism requirement, this explains the fact that (30a) allows the same-event reading, while (30b) does not.

Negated antecedent

Above we saw that Hardt and Mikkelsen (2015) claimed that negated antecedents for *same* were ruled out because of the parallelism constraint. In particular, since *same* required parallelism between the containing and antecedent clauses, a negated antecedent clause rendered it inaccessible, resulting in an ill-formed drs.

In (32) we show an analogous effect with an internal reading, where there is a negated antecedent, and we see that *same* is ruled out, although an ordinary definite description (without *same*) is acceptable.

(32) John **didn't read, but did skim** the book/*the same book.

As observed by Carlson (1987), a controller can be a coordinated element that is interpreted distributively. Here, we have two coordinated verbal elements. Crucially, the coordination includes a negative polarity in the first conjunct and positive polarity in the second.

$[v_0, v_1, v_2 | v_0 = \textbf{did\_not\_read}, v_1 = \textbf{did\_skim}, v_2 = v_0 \bigcup v_1];$
$\textbf{dist}_{v_2}([u_3, u_4, e_5 | john\{u_3\}, book\{u_4\}, e_5 : v_2\{u_3, u_4\}; *[\textbf{parallel}\{e_{5+4}, e_5\}])$

v_2	u_3	u_4	e_5
did_not_read	john	book1	not(read(john, book1))

*

v_2	u_3	u_4	e_5
skimmed	john	book2	skimmed(john, book2)

=

v_2	u_3	u_4	e_5	v_6	u_7	u_8	e_9
did_not_read	j	b1	not(read(j, b1))	skimmed	j	b2	skimmed(j, b2)

Here, we see that Parallel is applied to events e_5 and e_9 – it fails, because e_5 is negated.

Parallel antecedent

It was observed by Hardt and Mikkelsen (2015) that Parallel gives rise to a preference for predicates that are semantically related. For example, *praise* and *criticize* both entail a common property, *evaluate*. On the other hand, *investigate* and *reject* are not related in a parallel way; rather, *reject* in this case is a consequence of *investigate*. Here we see this effect with internal readings.

(33) a. John investigated and rejected the theory
b. * John investigated and rejected the same theory.

(34) John praised and criticized the same theory.

Below we show how this contrast is captured. We begin with the representation of the acceptable (34):

$[v_0, v_1, v_2 | v_0 = \textbf{praised}, v_1 = \textbf{criticized}, v_2 = v_0 \bigcup v_1];$
$\textbf{dist}_{v_2}([u_3, u_4, e_5 | john\{u_3\}, theory\{u_4\}, e_5 : v_2\{u_3, u_4\}; *[\textbf{parallel}\{e_{5+4}, e_5\}])$

v_2	u_3	u_4	e_5
praised	john	theory1	praised(john, theory1)

*

v_2	u_3	u_4	e_5
criticized	john	theory2	criticized(john, theory2)

=

v_2	u_3	u_4	e_5	v_6	u_7	u_8	e_9
praise	j	t1	praise(j, t1)	criticized	j	t2	criticized(j, t2)

We observe that Parallel is imposed on eventualities e_5 (praise(john, theory1)) and e_9 (criticized(john, theory2)). Because of the semantic relationship between *praise* and *criticize*, Parallel is satisified.

We turn now to the unacceptable (33b):

$$[v_0, v_1, v_2 | v_0 = \textbf{investigated}, v_1 = \textbf{rejected}, v_2 = v_0 \bigcup v_1];$$
$$\textbf{dist}_{v_2}([u_3, u_4, e_5 | john\{u_3\}, theory\{u_4\}, e_5 : v_2\{u_3, u_4\}; *[\textbf{parallel}\{e_{5+4}, e_5\}])$$

v_2	u_3	u_4	e_5
investigated	john	theory1	investigated(john, theory1)

*

v_2	u_3	u_4	e_5
rejected	john	theory2	rejected(john, theory2)

=

v_2	u_3	u_4	e_5	v_6	u_7	u_8	e_9
investigated	j	t1	investigated(j, t1)	rejected	j	t2	rejected(j, t2)

Here, Parallel is imposed on eventualities e_5 (investigated(john, theory1)) and e_9 (rejected(john, theory2)). The predicates *investigate* and *reject* don't have a non-trivial entailed property, and thus Parallel is not satisified.

6. Conclusions

Hardt and Mikkelsen (2015) show that *same* differs from other, related expressions, in that it gives rise to a parallelism requirement that must hold between the containing clause and an antecedent clause. They show this by presenting three types of parallelism effects: distinct antecedent, negated antecedent, and parallel antecedent. These effects were all shown to hold for external readings – cases where the antecedent clause and the containing clause appear in separate, overt predications. Although Hardt and Mikkelsen's account is formulated to apply in the same way for internal readings, they do not show that parallelism has clear effects in the case of internal readings.

In this paper, I have shown that all these parallelism effects, distinct antecedent, negated antecedent, and parallel antecedent, apply to internal readings just as they do for external readings. This is perhaps surprising – discourse constraints such as parallelism typically are applied to separate overt predications, rather than the implicitly distinct predications that arise in distributional structures.

I think these parallelism effects have not previously been observed for internal readings, because the typical internal readings have involved quantificational NP controllers, such as (2).

In such cases, it is difficult to see how to construct examples that potentially violate parallelism. In this paper we have seen that they are readily constructed in examples involving controllers that are coordinated verbal categories. These examples can give rise to implicit predications that are not necessarily parallel, since the coordinated elements can differ in polarity, event structure or the semantic content of the predication, all of which are crucial in satisfying parallelism.

While it is well-established that anaphoric elements are sensitive to parallelism, the observations in this paper, like those of Hardt and Mikkelsen (2015), do not merely show that parallelism is relevant to the interpration of *same*. Rather, the claim is that *same* is unacceptable in the absence of parallelism, and this is captured quite directly, by making the parallelism constraint part of the lexical meaning of *same*. The observations in this paper provide additional support for this view.

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Presupposition projection from disjunction in online processing[1]

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Abstract. Stalnaker (1973, 1974) suggested that presuppositions are evaluated dynamically in a way that crucially takes into account the 'left-to-right' unfolding of linguistic expressions. Recently, even more explicit considerations of the timing of online processing have been invoked to account for patterns of presupposition projection (e.g. Schlenker, 2008, 2009; Chemla and Schlenker, 2012; Hirsch and Hackl, 2014). However, relatively little is known about the actual time course of presupposition interpretation, in particular in environments that involve projection. In this paper, we take disjunction as our testing ground, and use visual world eye tracking data to shed light on the unfolding of presupposition projection in real time. Our key generalization is that presuppositions are evaluated immediately when the interpreter encounters the trigger in the left-to-right parse, bearing out a key assumption in the relevant theoretical literature, namely that presupposition projection can be related to incremental processing.

Keywords: presupposition, presupposition projection, disjunction, eye-tracking, visual world paradigm, experimental pragmatics

1. Introduction

A central issue in presupposition theory is the problem of *presupposition projection*: how are the presuppositions of a complex sentence determined from those of its atomic parts? As shown in (1), presuppositions interact with certain embedding expressions differently from entailments:

(1) a. The bathroom is in a funny place.
    b. The bathroom is not in a funny place.

The entailed contribution of the predicate *is in a funny place* is affirmed in (1a), but denied in (1b). Yet, the inference that there is a bathroom, introduced by the definite description *the bathroom* is conveyed by both sentences: the existence presupposition of the definite description projects from the scope of negation in (1b).

In this paper, we study the interaction between presupposition projection and *online processing*, focusing on *co-ordinate constructions*, which exhibit a complex pattern of projection effects. In the general case, presuppositions project from both the first and second co-ordinate: both of the sentence variants in (2) presuppose that there is a bathroom.

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(2) a. The rooms have odd shapes, and the bathroom is in a funny place.
b. The bathroom is in a funny place, and the rooms have odd shapes.

However, it has long been observed that presupposition projection from conjunction can depend on the linear order of the conjuncts, in particular in cases where the conjunct not containing the presupposition trigger entails the presupposition:

(3) a. There is a bathroom, and the bathroom is in a funny place.
b. #The bathroom is in a funny place, and there is a bathroom.

The effect of the first conjunct entailing the presupposition of the second conjunct in (3a) is that the sentence as a whole has no presupposition at all. In contrast, the reverse conjunct order in (3b) seems to be infelicitous. Intuitively, this is due to a clash between the requirement introduced by the presupposition in the first conjunct that it be taken for granted that there is a bathroom, and the presentation of that very notion as new information in the second, i.e., the redundancy of the second conjunct seems to induce infelicity here.

The simple example above suggests that linear order interacts with presupposition projection. Most early accounts of projection effectively stipulated this type of effect as a lexical property of sentential connectives (Karttunen, 1973; Heim, 1983). Recent approaches, though, have sought a more explanatory perspective by linking projection to online processing: asymmetric projection in conjunction emerges from the left-to-right nature of processing (Schlenker, 2009: cf. Schlenker 2008; Fox 2008; Chemla and Schlenker 2012; Hirsch and Hackl 2014). While this move towards greater explanatory adequacy is conceptually appealing, these approaches crucially rely on assumptions about online processing that have not been empirically tested, in particular with regards to how projection is evaluated in real time.

Our goal is to directly test one key assumption in this regard, namely (4), which we take to be an implicit or explicit feature of all accounts linking projection behavior to online processing:

(4) **Rapid Incremental Presupposition Evaluation ('RIPE')**
The interpreter decides whether or not a presupposition projects immediately when they encounter the trigger in the left-to-right parse.

Although (4) seems intuitive given general evidence for rapid incremental interpretation, it is not obviously borne out in all cases. An apparent corollary of (4) would seem to be that only material which *precedes* a given presupposition trigger should be able to influence whether or not the presupposition projects. However, there are cases where material *following* the trigger is relevant. Consider the contrast in (5), involving disjunction. (5b) is a well-known example due to Barbara Partee (Partee, 2005), and (5a) is a minimal variant thereof.

(5) a. Either the bathroom is in a funny place, or Mary is lost.
b. Either the bathroom is in a funny place, or there is no bathroom.

In both cases, the presupposition trigger (*the bathroom*) is in the first disjunct, while the second disjunct is varied, with an impact on projection: in (5a), the presupposition projects, but it does not in (5b), i.e. only (5a) gives rise to an inference that there is a bathroom. Indeed, the point of (5b) is to communicate agnosticism about whether there is a bathroom.

The pattern in (5) looks inconsistent with RIPE: if projection is evaluated in online processing as soon as the trigger is encountered, then downstream material should not play a role. Given this apparent evidence *against* RIPE, we take disjunction as our empirical object of study. To foreshadow, we argue that, despite initial appearances, disjunction is in fact compatible with RIPE, following Hirsch and Hackl (2014). Our main contribution here is to provide novel empirical evidence from visual world eye-tracking that directly supports RIPE in disjunction.

2. RIPE: motivation and puzzles

We begin by illustrating how asymmetric projection in conjunction can be derived from effects of real time processing (§2.1-2.3). The account we sketch follows Schlenker (2009) — and relies on RIPE. This motivates our choice to pursue RIPE. In the last part of the section, we make explicit the puzzle for RIPE posed by disjunction (§2.4-2.5).

2.1. Background: asymmetric projection in dynamic semantics

Stalnaker (1973) developed a seminal analysis of presupposition, by which presuppositions impose requirements on the discourse context. The context is modeled as the set of possible worlds in which all propositions mutually agreed upon by the conversational participants are true (the 'context set', c). A presupposition constrains c such that if a sentence S globally presupposes a proposition p, then S can only be felicitously uttered in contexts where p is true at every world in c. c is assumed to evolve as the discourse unfolds, and the felicity requirement applies to the context set that takes all previous parts of the discourse into account.

Heim (1983) extended Stalnaker's approach to a more general model of context update where the context relative to which a presupposition is evaluated is not necessarily c itself. To illustrate, consider conjunction. Heim models the denotation of lexical items not in terms of truth-conditions, but rather in terms of the impact they have on the context set (their 'context change potential'). Conjunction is defined to sequentially update c with the propositions expressed by the two conjuncts ('+' corresponds to intersection applied to the sets of possible worlds that c, ϕ_1, and ϕ_2 stand for):

(6) a. 'S_1 and S_2' uttered in context c
b. $(c+\phi_1)+\phi_2$

The key consequence of this sequential update is that S_1 and S_2 are interpreted relative to different contexts: S_1 is directly evaluated relative to c, while S_2 is interpreted relative to a context c' resulting from updating c with the proposition expressed by S_1 ($c' = c + \phi_1$). In turn, presuppositions triggered in the two conjuncts are evaluated differently: a presupposition of S_1 must be true at all worlds in c, while a presupposition of S_2 must be true at all worlds in c'.

Heim's system is well suited to capture asymmetric projection in conjunction. Concretely, recall (7), where the presupposition trigger *the bathroom* occurs in the first conjunct:

(7) #The bathroom is in a funny place, and there is a bathroom.

The presupposition is evaluated relative to c and imposes the requirement that the make-up of c conform to (8). By constraining the initial context, the presupposition is felt to project.[2]

(8) $\mathrm{c} \subseteq \{\mathrm{w} : \text{there is a bathroom in w}\}$

The situation is different when the order of the conjuncts is permuted in (9). In this case, the presupposition is evaluated relative to the context c' output by updating c with the first conjunct (*There is a bathroom*), as in (10a). The presupposition of *the bathroom* then places the constraint on c' in (10b).

(9) There is a bathroom, and the bathroom is in a funny place.

(10) a. $\mathrm{c}' = \mathrm{c} \cap \{\mathrm{w} : \text{there is a bathroom in w}\}$
b. $\mathrm{c}' \subseteq \{\mathrm{w} : \text{there is a bathroom in w}\}$

Because c' only contains those worlds in c at which there is a bathroom, the condition in (10b) is necessarily met, independent of the original make-up of c. Thus, the presupposition does not place any constraint on the initial context and is not felt to project.

2.2. From lexical stipulation to online processing

While Heim's approach offers an elegant analysis for the projection properties of conjunction (and other connectives), it does not achieve full explanatory adequacy. Heim relies on a specific lexical entry for conjunction, which is not formally motivated on independent grounds. In particular, nothing in the framework rules out an alternative entry for conjunction where the conjuncts update the initial context in the reverse order (Rooth p.c. to Heim, Soames 1989, Heim 1990):

(11) a. 'S_1 and S_2' uttered in context c
b. $(c+\phi_2)+\phi_1$ *cf. (6b)*

[2]Note that not only is the presupposition felt to project in (7), but the conjunction as a whole is also felt to be degraded. This is easily explained by the fact that the second conjunct winds up as contextually trivial, as it does not add anything new to c. Stalnaker (1973) already argued this to be a violation of a constraint against redundancy.

With this entry, S_2 is interpreted relative to c, and S_1 is interpreted relative to c+ϕ_2. Thus, presuppositions would always project from the *second* conjunct, but variably from the *first* conjunct, depending on the content of the second.

It does not seem to be a lexical idiosyncracy that update proceeds as in (6), and not as in (11). In (6), update proceeds left-to-right, as c is updated with the first conjunct and then the second. In (11), update proceeds right-to-left. The correlation between update order and the left-to-right linear order of the conjuncts can be explained in a principled way if update is directly linked to online processing. This is the direction pursued in recent work, and we outline one illustrative approach here: Schlenker's (2009) theory of local contexts.

Departing from Heim, Schlenker returns to a classical semantic framework, where sentence meanings are modeled as truth-conditions. When interpreting a sentence S in a context c, the interpreter must determine whether the proposition S expresses (ϕ_S) is true or false at each world in c. Worlds at which ϕ_S is true should be kept in c and worlds at which ϕ_S is false should be eliminated. Schlenker proposes that, when the interpreter parses a sub-constituent E of S, they simplify their task as much as possible by disregarding those worlds in c at which they can be sure that the interpretation of E does not affect the overall truth-value of S. The set of worlds under consideration when E is processed is the *local context* for E. Local contexts are computed online, so only information preceding E can be taken into account when determining its local context.

Let us consider how Schenker's approach applies to conjunction. Two stages of the left-to-right parse for a schematic conjunction are flagged in (12):

(12) [0] S_1 and [1] S_2

At stage [0], the interpreter starts by considering all worlds in c, and c itself is thus the local context for S_1. After parsing S_1, the interpreter can identify worlds in c at which ϕ_1 is true and false. Because $\phi_1 \wedge \phi_2$ is necessarily false if ϕ_1 is false, ϕ_2 only affects the truth-value for the conjunction at worlds where ϕ_1 is true; at those worlds, the conjunction is true if ϕ_2 is true and false otherwise. Accordingly, when they parse S_2, the interpreter only considers worlds at which ϕ_1 is true: the local context for S_2 is $c + \phi_1$. With the local contexts for S_1 and S_2 being c and $c + \phi_1$, the dynamics of context update closely mirror Heim's entry in (6).

Since context update is integrated with online processing, the only way for presupposition projection behavior to be linked to context update is for it too to be integrated with online processing – and, in this way, we arrive at the need for RIPE (which is implicit in Schlenker's discussion). For concreteness, consider the parse of (7) above with the stages shown in (13):

(13) [0] The bathroom [1] is in a funny place and [2] there is a bathroom.

At stage [0], parsing of the first disjunct begins and the local context is c. With RIPE, the presupposition is evaluated immediately on encounter of *the bathroom* at stage [1]. At this point, the local context remains c, so the presupposition is evaluated relative to c and projects.[3]

Permuting the conjunct order results in the presupposition being evaluated in a different local context, exactly as in Heim's system:

(14) [0] There is a bathroom and [1] the bathroom [2] is in a funny place.

At stage [1], the local context for the second conjunct, c', is determined by updating c with the proposition that there is a bathroom. Then, at stage [2], the presupposition of *the bathroom* is evaluated relative to c'. Just as for Heim, the presupposition is guaranteed to be satisfied in c' regardless of the make-up of c, so fails to project.

In sum, by integrating context update and presupposition evaluation with online processing, Schlenker achieves the same predictions as Heim did, but without lexical stipulation. RIPE plays a key role in the account, as it ensures that a presupposition is evaluated relative to the local context for the conjunct in which that presupposition is triggered.

2.3. Previous evidence for RIPE

Given conceptual rationale for RIPE, we ask: what empirical evidence can be used to directly test RIPE? While psycholinguistic work on the online processing of presupposition is still in a nascent state, early results seem to accord with RIPE.

Several self-paced reading studies have shown fairly immediate effects of contextual manipulations bearing on the status of presuppositions, with increased reading times when the context was inconsistent with the presupposition (Schwarz, 2007; Tiemann et al., 2011). This is in line with presuppositions being evaluated right away when the trigger (and other material in the sentence required to flesh out the content of the presupposition) is encountered. Schwarz and Tiemann (2016) further corroborate this with temporally more fine-grained reading time measures from eye-tracking during reading, and Schwarz (2014, 2015); Romoli et al. (2015) provide parallel evidence from visual world eye tracking.

There is, however, a limitation to the previous results: the bulk of evidence for RIPE comes from studies looking at presupposition triggers in simple, unembedded contexts, so no issues of projection arise.[4] This is potentially problematic insofar as the predictions of RIPE could be descriptively adequate for unembedded occurrences of presupposition triggers, but not extend to embedded contexts where projection is an issue. By studying co-ordination, our experiments

[3]As we discussed earlier (cf. (3b)), the presupposition marks its content as information taken for granted in the global context, and continuing the sentence by asserting it results in redundancy. (Note that the presupposition equally affects the local context for the second conjunct, since it is a subset of the global context.)

[4]The key exception to this is Schwarz and Tiemann (2016), who look at the presupposition of *again* under negation and in conditionals, with results that they argue show that evaluating projection presuppositions relative to the global context takes longer than in the case of unembedded ones; we return to the relation between our results and theirs in the general discussion.

directly assess whether RIPE makes adequate predictions when projection is involved. We focus on disjunction which seems to pose a particular challenge for RIPE.

2.4. The disjunction puzzle

Schlenker's incremental system makes a key prediction for disjunction: when a presupposition trigger occurs in the first disjunct, the presupposition should project, just as presuppositions project from a first conjunct. Consider the disjunction data seen earlier:

(5) a. [0] Either the bathroom [1] is in a funny place, or [2] Mary is lost.
b. [0] Either the bathroom [1] is in a funny place, or [2] there is no bathroom.

Regardless of the connective, the local context at the outset of the parse is *c*. Given RIPE, the presupposition is evaluated at stage [1], relative to *c*. Thus, the presupposition should constrain *c* and be felt to project.

The prediction is borne out in (5a) – but fails in (5b). Whether or not the presupposition projects, then, depends on the second disjunct. When the second disjunct is independent of the presupposition, it projects, as in (5a). But, at least when the second disjunct expresses the negation of the presupposition, it does not project, as in (5b). This effect of the second disjunct looks at odds with RIPE, since the second disjunct is not encountered until stage [2], after the presupposition is evaluated at stage [1]. Given RIPE, it looks as though the second disjunct comes too late to influence projection.

One reaction to this puzzle may be to abandon RIPE so that the interpreter delays all projection decisions until the end of the sentence. In that case, we would expect that projection could be affected both by information that precedes and follows the presupposition trigger. In fact, this option is explicitly considered by Schlenker, who suggests that the asymmetries that can ultimately be attributed to RIPE merely have the status of a processing preference, and can in principle be overriden by a symmetric evaluation of presuppositions. In doing so, however, we lose a straightforward account of asymmetric projection in conjunction[5] and must regress to lexical stipulation to account for the contrast in (a)symmetry between the two types of coordination.[6] Here, we pursue the possibility that the disjunction data can be reconciled with RIPE.

2.5. Reconciling Disjunction with RIPE

Hirsch and Hackl (2014) suggest a way to reconcile the disjunction pattern with RIPE. In their

[5] But note that the empirical picture for conjunction is less clear than it may seem at first. For an attempt at settling this experimentally, see Mandelkern et al. (2017), who do not find any evidence for symmetric projection in conjunction.

[6] In principle, one could also consider a processor that waits to assess projection until the end of the sentence but then bases its computations on linear order, but this would effectively bring us back to stipulating an effect of order, rather than deriving it independently, so we will leave this possibility aside in what follows.

view, the interpreter always makes a decision about whether or not to project a presupposition immediately on encounter of the trigger, but that decision can be revised later in the parse. RIPE is correct, but commitments made at intermediate stages of parsing can be altered.

We start with the first part of the disjunction which is shared by (5a-b), and focus on two stages of the incremental parse, as annotated below.

(5a-b) [0] Either the bathroom [1] is in a funny place, . . .

Parsing of the first disjunct begins at stage [0], at which point the local context is the initial context set. At stage [1], *the bathroom* is encountered and, by RIPE, the interpreter evaluates the presupposition. The presupposition places the constraint on c in (8), so projects globally.

(8) $c \subseteq \{\text{w : there is a bathroom in w}\}$

This result accords with intuitions for (5a), but not (5b). Hirsch and Hackl's account for (5b) relies on a later stage of parsing, subsequent to stage [1]. Consider the full parse, including the second disjunct:

(5b) [0] Either the bathroom [1] is in a funny place, or there is no bathroom [2].

The core idea is that (5b) involves a pragmatic garden path, where the interpreter commits to projection immediately on encounter of the trigger at stage [1] – as expected based on RIPE – and then revises that commitment later at stage [2], after the second disjunct is encountered. The donwstream revision is motivated by independent principles of discourse interpretation. In particular, Hirsch and Hackl note that a disjunction *p or q* is subject to the felicity constraint in (15), motivated by general Gricean principles (see also Schlenker 2008):

(15) **Non-opinionatedness (NO)**
To felicitously use a disjunction *p or q*, the speaker must not believe p, $\neg p$. q, or $\neg q$.

If the condition in (8) holds, then the notion that the building in fact has a bathroom has to become part of the common ground prior to evaluation of the disjunction in (5b). This means that the speaker must believe (or is at least acting as if they believed) that the building has a bathroom, which in turn commits the speaker to believing that the second disjunct in (5b) is false. In other words, because the second disjunct is equivalent to the negation of the presupposition, projecting the presupposition leads to a violation of Non-Opinionatedness. Having committed to projection at stage [1], the interpreter inevitably runs into an NO violation when they parse the second disjunct at stage [2]. This, Hirsch and Hackl propose, leads to the interpreter back-tracking on their earlier commitment so as to respect NO. This can be done by appealing to some version of a local accommodation operator (Heim, 1983), which effectively results in presupposed content being treated on par with regular entailed content (also see the A-operator of Beaver and Krahmer, 2001).

Note that NO is a principle that applies specifically to disjunctions. As a result, the situation in conjunctions is not parallel, and it does not come as a surprise under this view that one does not seem to observe the same right-to-left filtering in the case of conjunctions (also see footnote 5). This proposal therefore offers an explanatory account of the contrast in incrementality between conjunctions and disjunctions, and thus escapes the stipulative aspect of an alternative approach *à la* Heim where the two connectors are lexically defined to meet the projection observations.

2.6. Section summary

We have seen that RIPE is a central assumption of an account linking asymmetric projection in conjunction to online processing – an account achieving significant explanatory depth. Though disjunction seems to provide counter-evidence, Hirsch and Hackl suggest that disjunction could be compatible with RIPE after all. The goal now is to directly test whether RIPE holds in disjunction. We use visual world eye-tracking experiments to assess the time course of presupposition projection, and in particular to test whether commitments to projected presuppositions are reflected in eye movements prior to the second disjunct having fully unfolded.

3. Experiment 1: trigger in first disjunct

Exp. 1 investigated disjunctions with a presupposition trigger in the first disjunct. Consistent with RIPE, our results support Hirsch and Hackl's idea that the interpreter rapidly assumes that the presupposition projects upon encountering the trigger, before the second disjunct unfolds.

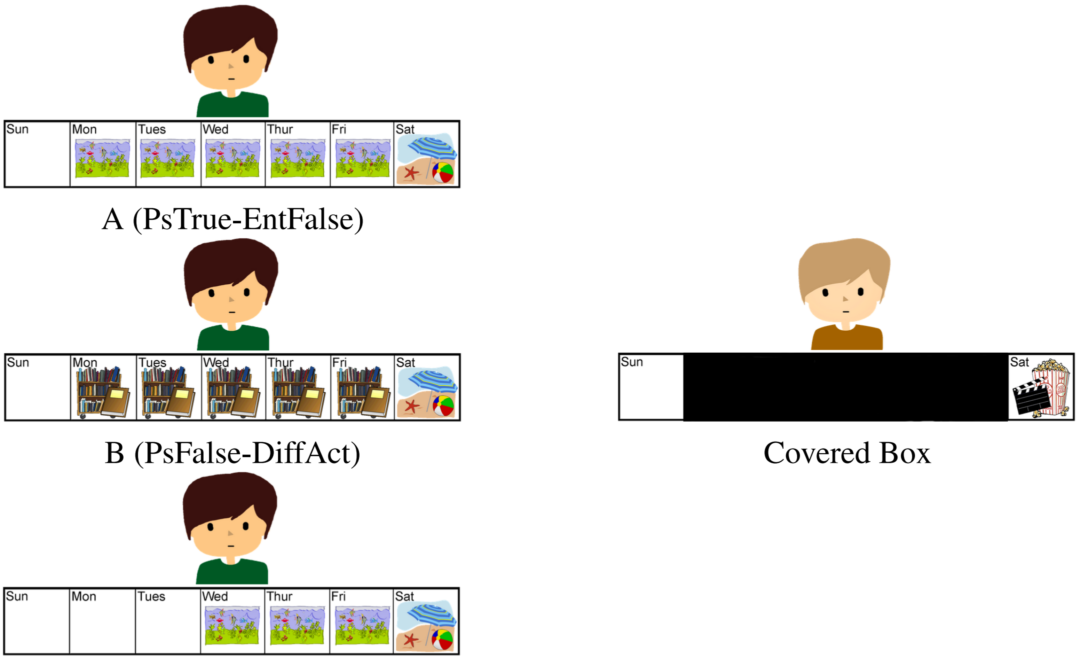
3.1. Design & Methods

The experimental stimuli included disjunctions like (16), with the presupposition trigger *stop* in the first disjunct. In (16), *stop* triggers the presupposition that Henry went to the aquarium prior to Wednesday (in shorthand: *Aquarium*<*Wd*). The assertion in the first disjunct is that Henry did not go to the aquarium from Wednesday on (¬*Aquarium*>*Wd*).

(16) Either Henry stopped going to the aquarium on Wednesday,
or he waited until Saturday to go to the movies.

Participants heard recordings of sentences like (16) while their gaze was tracked relative to a visual display. The visual display consisted of three pictures, each containing a character and a calendar strip with iconically represented activities (Schwarz, 2014), as in Figure 1. Participants' task was to choose the character they took the sentence to be about.

The crucial picture is the target picture, which came in three variants, corresponding to three experimental conditions, illustrated in Fig. 1A-C. In addition, there was a distractor picture and a 'covered box' (adapted from Huang et al., 2013), where crucial information on what happened on relevant days in the calendar strip is blacked out.



A (PsTrue-EntFalse)

B (PsFalse-DiffAct)

C (PsFalse-SameAct)

Covered Box

Figure 1: Illustration of Target variants and Covered Box for Exp. 1

The logic of the design was to manipulate whether or not the presupposition of *stop* was met in the target picture, and assess whether the presupposition being met increased the likelihood of participants fixating on the target as the sentence unfolded. In Condition A, the presupposition is met: for the sample item above, Henry went to the aquarium before Wednesday in A. In Conditions B-C, the presupposition fails, since other activities took place prior to Wednesday (Condition B), or no activities did (Condition C). In the item above, the character went to the library prior to Wednesday in Condition B. We refer to B as the DiffActivity (PsFalse) condition and C as the SameActivity (PsFalse) condition. While B constitutes a minimal control condition for A in that they share the same day structure, C was included to control for any independent effect of the presence of slots featuring the mentioned stopped activity.

While the target varies in whether or not the presupposition is satisfied, the distractor picture (not shown) is incompatible with the presupposition in all cases. In the covered box, activities prior to Wednesday are obscured, so the presupposition *could* be satisfied, but is not necessarily so: in the sample item, the character may or may not have gone to the aquarium on Monday and Tuesday. In this way, the covered box is always *compatible* with the presupposition.

Factoring in the assertion now, neither target variant ultimately verifies both the presupposition and the assertion. In Condition A, where the pesupposition is verified, the assertion fails, since the character continued to go to aquarium after Wednesday, and went to the beach, not the movies, on Saturday. In Conditions B and C, the presupposition fails, as discussed, and the assertion fails as well. The covered box is ultimately, then, the only picture participants can select: in the covered box, the character does go to the movies on Saturday, verifying the non-presupposing disjunct.

Since we are interested in the online looking pattern, however, more important for our purposes is the status of the assertion *prior to the end of the sentence*. We focus on the critical region underlined in (16). Prior to encounter of *movies* at the end of the sentence, all pictures are still potentially compatible with the assertion, since all have an activity on Saturday. In this way, we can isolate effects of presupposition at this point.

Predictions The critical measure is the relative proportion of fixations on the target relative to the covered box in the online data. If participants rapidly compute the presupposition of *stop* and assume projection, per RIPE, an effect of condition should emerge in the critical region: participants should be more likely to fixate on the target image in Condition A (PsTrue) than in either Conditions B or C (PsFalse). In those conditions, their gaze should be drawn to the covered box comparatively more strongly, since the covered box is the only potential presupposition match. On the other hand, if presuppositions are not rapidly evaluated on account of the trigger, but rather are deferred until the full disjunction is fully processed, no effect of condition is predicted. For the behavioral measure, participants are expected to select the covered box as the best overall picture match in all cases, as discussed.

While RIPE predicts an effect of condition during the critical region, an alternative lexicalist approach which stipulates that disjunctions project a conditional presupposition *symmetrically* for triggers in either disjunct does not. If the semantics of disjunctions is such that the second disjunct can affect whether or not a presupposition introduced in the first disjunct has to be met globally (cf. (11b)), then the evaluation of this presupposition most plausibly would be deferred until the second disjunct is processed. In that case, no effect of condition should emerge in the critical region.

Participants and Procedure 24 items were created with the properties described above, with 4 versions each (a fourth control condition, not discussed here for reasons of space, had a target where both the presupposition and the entailed content of the first disjunct were true). In addition, there were 30 fillers, all of which involved disjunctions, with varying properties (such as truth of 1st vs. 2nd disjunct, presence of presupposition trigger, etc.) to counterbalance a number of different factors across the experiment. 35 students at the University of Pennsylvania participated for course credit. The experiment was implemented in the Experiment Builder software by SR Research, and data was collected on an EyeLink 1000 eye tracker.

3.2. Results

Data Analysis Eye movement data were analyzed beginning at the onset of the disjunction marker *or*, in order to measure proportions of looks to the target after the first disjunct had been fully heard but before the second disjunct had been completed. Since the key alternative candidate for matching the disjunction was the covered box (which was compatible with a global interpretation of the presupposition), we computed a target advantage score where looks to the covered box were subtracted from looks to the target. For purposes of analysis, proportions were transformed to Elogits, and the analysis for individual time-windows used mixed effect models with subjects and items as random effects, as well as a slope for condition to the extent

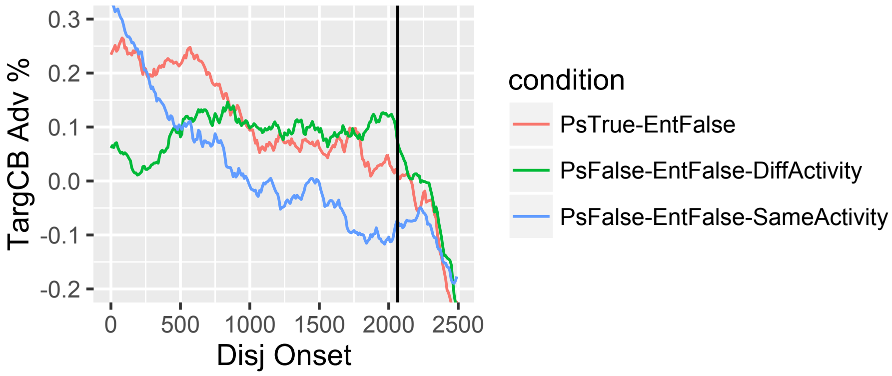


Figure 2: Looks to Target-Looks to Covered Box by Condition relative to onset of 'or'

that these models converged. Significance of individual effects was assessed through model comparisons with minimally varied models where the condition-factor had been removed.

The graph in Fig. 2 illustrates Target Advantage scores over time for the second disjunct (the black line indicates the mean disambiguation point, corresponding to the onset of *movies* in (16)). There is a clear effect of presupposition: during the second disjunct, participants are significantly more likely to fixate on the target in Condition A (PsTrue) than in Conditions B-C. The contrast with condition B (DiffActivity) is present early on (0-500ms; $\beta = 2.14$, $SE = 0.61$, $t = 3.52$, $\chi^2 = 10.06$, $p < 0.01$), but does not last throughout. The contrast with condition C (SameActivity) emerges first in the 500-1000ms time window ($\beta = 1.48$, $SE = 0.60$, $t = 2.47$, $\chi^2 = 6.08$, $p < 0.5$), and lasts through the remainder of the ambiguous period.

Discussion The contrast in the proportion of looks in the second disjunct indicates that the manipulation of whether or not the presupposition is met in the target picture has an effect. This is consistent with the idea that the interpreter assumes projection online, i.e. when the trigger is in the first disjunct, they immediately compute the presupposition and assume projection. This is in line with the prediction of RIPE, but not with an alternative possibility where the potential relevance of the second disjunct for projection is taken into consideration before any consideration of the presupposition is undertaken.

4. Experiment 2: trigger in second disjunct

In Experiment 2, we extend the data set by testing whether RIPE is supported when the presupposition is triggered in the *second* disjunct, rather than the *first*. Again, our results support the idea that the presupposition is rapidly computed and assumed to project online.

4.1. Extending to trigger-second order

As a first step, let us consider what the incremental system we sketched based on Schlenker (2009) predicts for a disjunction with a presupposition trigger in the second disjunct. The disjunction in (17) offers an illustration:

(17) Either [0] Mary's lost, or [1] the bathroom [2] is in a funny place.

As with any parse, the local context at stage [0] is simply the entire context set, c. At stage [1], the local context for the second disjunct, c', is determined. A disjunction S_1 *or* S_2 is true at any world where one or both of ϕ_{S1} and ϕ_{S2} is true. The content of S_2, therefore, affects the truth-value of $\phi_{S1} \vee \phi_{S2}$ only at worlds which ϕ_{S1} is false. As such, c' in (17) is that subset of c containing only worlds at which Mary is not lost:

(18) $c' = c \cap \{w : \text{Mary is not lost at w}\}$

At stage [2], *the bathroom* is encountered and the presupposition is evaluated relative to c'. For it to be satisfied, the building must have a bathroom at every world in c', as in (19a). The predicted overall presupposition, then, can be paraphrased as the conditional in (19b).

(19) a. $c' \subseteq \{\text{w : the building has a bathroom at w }\}$
b. If Mary isn't lost, the building has a bathroom.

In predicting a conditional presupposition, Schlenker's approach converges with proposals in dynamic semantics which stipulate an entry for *or* by which a presupposition triggered in the second disjunct projects as conditional (Beaver, 2001: contra Geurts 1999). Yet, this prediction is problematic. Intuitively, (17) does not presuppose (19b), but rather something stronger: the presupposition is simply that the building has a bathroom, independent of whether or not Mary is lost. Observing a non-conditional presupposition where a conditional is predicted is known as *the proviso problem*. Though the proviso problem may seem to argue against an account like Schlenker's altogether, the situation is more complex, as there are examples where a conditional presupposition is observed. A well-known case is (20) (adapted from Geurts, 1996: p. 271), where the intuited presupposition is that if John is a diver, he has a wetsuit.

(20) Either John isn't a diver, or he brought his wetsuit on the trip.

To explain the non-conditional presupposition of (17), many authors accept the prediction of a conditional presupposition, but augment the account with a pragmatic mechanism which strengthens the conditional to a non-conditional. In (17), (19b) is strengthened to (21):

(19b) If Mary isn't lost, the building has a bathroom.
(21) The building has a bathroom.

Different accounts of strengthening have been advanced (van der Sandt, 1992; Geurts, 1999; Beaver, 2001; Singh, 2007; Schlenker, 2011; Lassiter, 2012). While we cannot go into great detail for reasons of space, the last two in particular lend themselves to an integration with the present discussion. Briefly, they assume that conditional presuppositions get strengthened if the material featuring in the antecedent is taken to be irrelevant for whether or not the presupposition holds. For Schlenker (2011), in particular, this is introduced as a process that makes reference to left-to-right order in processing, parallel to the motivation for RIPE above: preceding material can be considered for presupposition evaluation, but also can be deemed irrelevant in this regard if it contextually fails to bear on whether or not the presupposition holds. For our purposes, this suggests that resolving the proviso problem is a process that takes place equally rapidly as presupposition projection in general, so that strengthened presuppositions should be detectable in online processing measures. Experiment 2, then, directly extends the approach from Experiment 1 by looking at the effect of presupposition triggers in the second disjunct.

4.2. The paradigm

The test sentences in Experiment 2 consisted of disjunctions such as (22), where the aspectual verb *continue* occurs in the second disjunct and triggers the presupposition that Henry went to the movies prior to Wednesday (movies<Wd).

(22) On Wednesday, Henry either went to the aquarium, or he continued going to the movies.

As in Experiment 1, each test sentence was paired with a visual display made up of three pictures: a target, a distractor, and a covered box. The target picture was varied between two experimental conditions, as in Fig. 3.[7] In both, the first disjunct (that Henry went to the aquarium) is true. In Condition A, the presupposition of *continue* is met as well, as Henry went to the movies on Sunday, Monday, and Tuesday. In Condition B, Henry did not go to the movies before Wednesday (but only after Wednesday), so the presupposition is false. Thus, the target image in both conditions is compatible with the asserted content of the disjunction as a whole (given that it matches the first disjunct), but differs minimally between conditions in whether the presupposition is verified (version A; hence, PsTrue) or not (version B; PsFalse). In the covered box, Henry's activities on Monday, Tuesday, and Wednesday were obscured, as in (3), leaving it open whether or not the presupposition (or the disjunction as a whole) is matched in this picture. The distractor (not show here) was neither compatible with the presupposition nor the assertion, as it had a different activity prior to Wednesday.

Predictions The crucial data are again provided by the online eye-tracking measure. In this case, we define the critical region as extending from the onset of *continue* to the onset of the last word of the sentence, as in (22). Note that, unlike in Experiment 1, the presupposition trigger itself is part of this critical region. While the full second disjunct is needed to flesh out the content of the presupposition (that Henry went to *movies* before Wednesday), the encounter of *continue* alone already suffices to draw the inference that the character in question had *some* sequence of activities preceding Wednesday. As a result, already at the beginning of the critical region, we may see an effect of condition. A greater proportion of looks to the target is expected in Condition A (some activity on Monday-Wednesday) than in Condition B (no activity on these days). As the noun *movies* is encountered, this asymmetry should remain since the target in A satisfies the full presupposition (that Henry went to the *movies* prior to Wednesday). But, crucially, an effect prior to *movies* can give clear evidence that the presupposition is considered rapidly, prior to the end of the clause (even before the full content of the presupposition has been provided).

[7] In addition, there were two further conditions where the first disjunct was false in the target picture for counterbalancing purposes; we do not discuss these here in detail for reasons of space.

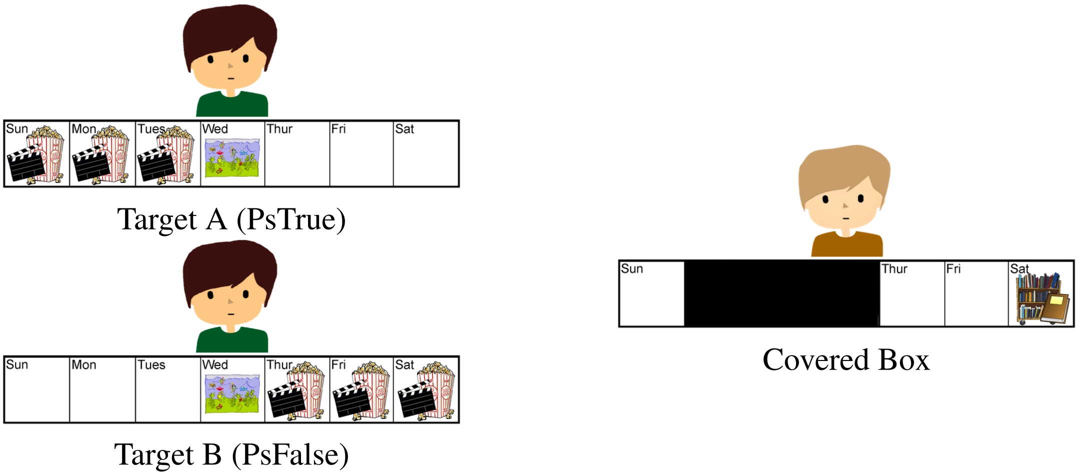


Figure 3: Illustration of Target variants and Covered Box for Exp. 2

To re-iterate, any effect of condition in Experiment 2 would implicate *two* rapid online processes relating to presupposition interpretation. First, the presupposition of *continue* has to be considered rapidly for any effect to arise. Secondly, the relationship of this presupposition to the preceding linguistic context has to be determined immediately as well, to determine that having gone to the aquarium on Wednesday (the content of the first disjunct) is not likely to bear on the question of going to the movies prior to Wednesday, leading to strengthening of the presupposition to a non-conditional one (assuming, as before, a conditional presupposition, in line with a RIPE-based account of projection, to begin with).

The secondary measure of picture selection is also informative in Experiment 2, as it allows us to assess whether participants adopt a strengthened non-conditional presupposition in the final interpretation. In Condition A, the target matches the strengthened presupposition and assertion, so is the expected response regardless. In Condition B, however, the strengthened presupposition is not met, so participants must select the covered box if they adopt that interpretation. Otherwise, if they compute a conditional presupposition or locally accommodate a strengthened presupposition, they can select the overt picture. In addition to the selection itself, we collected reaction time data from the offset of the sentence to the time of picture selection.

Participants & Procedure The experimental stimuli consisted of 24 items structured as in the sample item above. In addition, there were 30 filler items, again varying crucial properties, such as presence of a trigger and truth or falsity of the disjunction as a whole, for purposes of counterbalancing to avoid potential experiment-level strategic effect and to mask the experimental manipulations. 48 undergraduate students at the University of Pennsylvania participated in the experiment for course credit. As in Exp. 1, the experiment was implemented in Experiment Builder, and data was collected on an EyeLink1000 eye tracker.

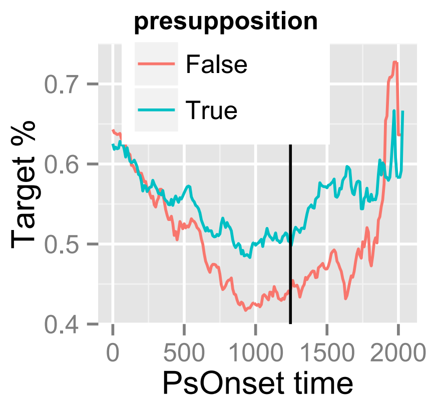


Figure 4: Proportion of looks to Target by condition in Exp. 2, relative to the onset of *continue*. Black line marks mean disambiguation point (corresponding to *movies* in (22))

4.3. Results

Eye movement data The graph in Fig. 4 shows the proportion of looks to the target by condition relative to the onset of the presupposition trigger *continue*, with the black line again indicating the mean onset of the disambiguating word (*movies* in illustrations above).

A difference between the conditions with A (PsTrue) and B (PsFalse) versions of the Target emerges already before 1000ms after the onset of *continue*. This is reflected in a significant effect during the time-window starting with the onset of *continue* and ending with the onset of the disambiguating noun (the correlate of *movies*) as confirmed by mixed-effect model analyses on Elogit-transformed proportions of looks to target and subsequent model comparison ($\beta = 0.77$, $SE = 0.35$, $t = 2.18$, $\chi^2 = 4.61$, $p < 0.5$), suggesting that the presupposition of *continue*, that some activity must have been going on prior to Wednesday, is already having an effect on the interpretation prior to the full second disjunct unfolding. This is consistent with the prediction of RIPE. Right after participants encountered *continue*, they are more likely to fixate on the target if the presupposition is verified than if the presupposition fails.

Behavioral data Beginning with response pattern by condition, participants were more likely to select the target picture in Condition A (96%), where the presupposition was met, than in Condition B (75%), where is was not, but where the covered box offered a viable alternative choice where the presupposition could be met. A logistic mixed-effect model analysis revealed this difference to be statistically significant ($\beta = 3.45$, $SE = 0.52$, $z = 6.59$, $p < 0.001$).

While Condition A and Condition B differ, it is notable that participants still do select the target with high frequency in Condition B (75%). This suggests that participants often do *not* have a strengthened presupposition projected in the final interpretation. This looks initially at odds with the online data which provide evidence for an effect of presupposition in the critical region. We suggest that those target choices obtained after participants strengthened the conditional presupposition, but then revised this strengthening.

This explanation is further consistent with the reaction time data.

Reaction times by condition and response choice also reveal a telling pattern. Fairly unsurprisingly, covered box choices when the presupposition was not met in the target picture (Condition B) were slower than target choices (8061 vs. 6874 ms respectively). However, target choices were furthermore significantly faster when the presupposition was met (6297ms, version A), as confirmed by mixed effect model analyses and model comparison ($\beta = -653$, $SE = 281$, $t = -2.33$, $\chi^2 = 4.97$, $p < 0.5$). This suggests that even though the target picture was the majority choice overall in the B version, this choice was not as straightforward as in the A version, presumably due to the difference in the presupposition being met. Importantly, such a delay would not be expected if target choices in Condition A and B equally obtained with a satisfied conditional presupposition.

5. Discussion

Our starting point in this paper was the observation of an asymmetry in presupposition projection in conjunctions. We argued that recent explanatory accounts for this asymmetry based on left-to-right processing share an implicit assumption, which we made explicit in the form of RIPE. We then reviewed cases that are not as clearly asymmetric, in particular disjunction. Facing this contrast between conjunctions and disjunctions, we were left with two alternatives: either give up the general asymmetric model based on RIPE and stipulate an asymmetric lexical entry for conjunctions and a symmetric entry for disjunctions, or maintain RIPE and explain apparent symmetry in disjunctions as resulting from a more complex process involving an initial commitment to projection, which is then rescinded in cases where this conflicts with independent pragmatic principles, in particular NO.

The goal of our experiments was to show that empirical evidence on processing is indeed consistent with RIPE, in that it reflects early commitments to projected presuppositions. We focused on disjunctions, where RIPE makes a crucial prediction: while RIPE predicts early commitment to presupposition projection, approaches that posit a symmetric entry for disjunctions would naturally account for speakers not committing to projection before encountering the entire second disjunct. We saw that the results are consistent with RIPE, in that our eye-tracking data from Experiment 1 suggest early commitment to presupposition projection, contrary to what is expected according to lexicalist approaches. We furthermore saw that a strengthening mechanism endorsed by most recent authors takes place rapidly when the presupposition trigger appears in the second member of a disjunction, which is again in line with a rapid processing and integration of presuppositions.

Taking the results at face value, especially those from Experiment 2, one might consider a third possibility, namely that presuppositions are initially taken to project unconditionally from the first and second disjuncts as well. That is, one might interpret the results of the second experiment not as showing that there is rapid strengthening of an underlying conditional presupposition (as we concluded), but rather as showing that processing presuppositions does not take preceding information into consideration at first. Such an interpretation would be reminiscent of some early accounts of presupposition projection, endorsing what is known as the cumulative hypothesis (Langendoen and Savin, 1971). The presupposition-suspension mechanism (e.g. local accommodation) involved in Hirsch and Hackl's back-tracking mechanism, which is used to account for the optionality of projection from the first member of a disjunction, could then be held responsible for the optionality of projection from the second member despite the posited initial commitment in projection. While this view would be compatible with our results taken in isolation, we argue that it is not tenable in the more general landscape of presupposition projection. First, as illustrated with the sentence in (20), presuppositions sometimes project *conditionally* out of disjunctions. This observation is at odds with a parser that would *unconditionally* project presuppositions as soon as it encounters a trigger. Moreover, while a process such as local accommodation possibly taking place both in the first and second member of a disjunction is well in line with the apparent symmetry of disjunctions, it is hard to see how the mere availability of local accommodation could account for the asymmetry of conjunctions. By contrast, note that RIPE does not suffer the same criticism, since resorting to local accommodation in disjunctions is motivated by an independent pragmatic principle, Non-Opinionatedness, which does not apply to conjunctions: the lack of presupposition projection in conjunctions where a trigger appears in the second conjunct results from the conditional nature of the presupposition induced by incremental-processing , and not from local accommodation.

More generally, our results provide new insights into the online processing of presuppositions and therefore further constrain theories of presupposition projection. Insofar as decisions about presupposition projection are made right away, the range of options for lexically encoded projection properties, should there be the need for any, is substantially reduced. An important task to carry out in more detail in future work is to relate the present results to previous findings, such as those by Schwarz and Tiemann (2016), who conclude based on evidence from eye-tracking during reading that projection takes time. While that conclusion may at first sight seem at odds with the interpretation of our data offered here – that projection decisions are made rapidly –, this need not be the case, as the steps the processor engages in to determine whether a presupposition project could well start out right away when the trigger is encountered, and yet take time to complete. Furthermore, it is worth noting that the time-windows of our effects are only immediate in the broader sense that they show up prior to relevant further information having been introduced, which is again perfectly consistent with the notion that the overall process of presupposition projection does take a certain amount of time to complete. Finally, yet another important direction for future work is to extend the present methodology to other connectives, and in particular to settle the question of whether or not conjunctions display any genuinely symmetric projection effects.

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On the role of classifiers in licensing Mandarin existential wh-phrases[1]

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Abstract. As in many languages in the world, wh-phrases in Mandarin can be interpreted as more than interrogative, depending on where they appear. This paper focuses on one of the non-interrogative readings of Mandarin wh-phrases, the existential reading, and presents an account of the licensing conditions for this particular reading by examining its distribution. Moreover, this paper aims to tackle the issue concerning the required co-occurrence of existential wh-phrases and classifiers in certain environments, a puzzle that has received much notice (Li, 1992; Lin, 1998; Liao, 2011) but is not yet resolved. This paper argues that Mandarin wh-phrases require two ingredients to be existential, non-veridicality (Xie, 2007; Lin et al., 2014) and existential closure (∃) (Kratzer and Shimoyama, 2002). And classifiers play the role of providing existential force to the wh-phrase when ∃ is unavailable. The (un-)availability of ∃ is conditioned by the application site of ∃ and the syntactic heights of non-veridical operators, whose scope constitutes the licensing domain for the wh-phrase: ∃ is unavailable when it falls outside the scope of the non-veridical operators, given a licensing condition proposed in this paper that limits the application of ∃ to wh-phrases to being within a non-veridical domain. In that case, a classifier is required for the existential interpretation of the wh-phrase.

Keywords: Mandarin, classifiers, wh-phrases, non-veridicality, existential closure

1. Introduction

The interpretation of Mandarin wh-phrases can vary, depending on the environments they appear in. Besides the interrogative reading, (1a),[2] Mandarin wh-phrases can have other non-interrogative readings, one of them being **existential**, (1b) (Huang, 1982; Cheng, 1991, 1994, 1995; Li, 1992; Lin, 1996, 1998, 2004, 2014; a.o.):

(1) a. Zhangsan xihuan **shenme**?
Zhangsan like what
'What does Zhangsan like?'

b. Zhangsan **bu** xihuan **shenme**
Zhangsan not like what
'What doesn't Zhangsan like?'
'Zhangsan doesn't like anything.'

However, the existential reading is not readily available in all situations: A wh-indefinite is not grammatical in most positive episodic sentences (Li, 1992; Lin, 1998). The following sentence can only obtain an interrogative interpretation:

[1] I would like to thank my two main advisors of this project, Seth Cable and Vincent Homer, for enlightening me and leading me along the way. I would also like to thank Kyle Johnson, Rajesh Bhatt, and the audience at the UMass Semantics Workshop fall 2015 for their valuable comments and suggestions. Yangsook Park and Jon Ander Mendia have my biggest gratitude for helping me with some of the semantic issues in the project. Finally, I would like to thank Rong Yin for many of the judgements on the scope readings of the wh-phrases. Of course, any errors that remain would be my own.

[2] Unlike English, Mandarin is a wh-in-situ language. In other words, there is no overt movement of the wh-phrase to Spec.CP to take scope, as in the case of English. To obtain the reading where the wh-phrase takes scope over the matrix clause, it is generally assumed that wh-phrases are inherently quantificational and undergo LF movement to take scope. Please see Huang (1982) for a more detailed account of Mandarin wh-interrogatives.

(2) Zhangsan kandao-le **shenme**
Zhangsan see-ASP[3] what
'What did Zhangsan see?'/*'Zhangsan saw something.'

Various licensing conditions have been proposed for Mandarin existential wh-phrases. Yet one fact that has been noted in the literature but not accounted for is the required co-occurrence of these wh-phrases and classifiers in certain environments (Li, 1992; Lin, 1998; Liao, 2011):

(3) a. Zhangsan haoxiang mai-le-**(ge)** **shenme**
Zhangsan seem buy-ASP-CL what
'It seems that Zhangsan bought something.'
b. Zhangsan bixu mai-***(ge)** **shenme**
Zhangsan must buy-CL what
'Zhangsan must buy something.'

Being in the scope of epistemic and deontic modals (i.e. *haoxiang* ('seem') in (3a) and *bixu* ('must') in (3b)) is reported to be one of the licensing conditions for existential wh-phrases. But clearly, the obligatory presence of the classifier in the deontically modalized environment suggests that we need to take into account the role classifiers play in licensing existential wh-phrases that distinguishes between the licensing environments as those in (3).

In fact, the deontic environment is not the only environment that requires a classifier for existential wh-phrases. In the remainder of this paper, we will scrutinize the distributions of existential wh-phrases and classifiers. The goal is to develop an analysis that implements classifiers into the licensing conditions for the wh-phrases, capturing their distribution correlation.

1.1. Distribution of existential wh-phrases

The following are the reported environments where existential wh-phrases are licensed:

— Under negation, in polar questions, and in conditionals:
(Huang, 1982; Cheng, 1994; Li, 1992; Lin, 1996, 1998, 2004, 2014)

(4) Zhangsan **mei** chi **shenme**
Zhangsan not eat what
'Zhangsan didn't eat anything.'

(5) Zhangsan chi-le **shenme ma**?
Zhangsan eat-ASP what Q
'Did Zhangsan eat anything?'

(6) **Yaoshi** Zhangsan chi-le **shenme**, qing gaosu wo
if Zhangsan eat-ASP what please tell me
'If Zhangsan eats anything, please tell me.'

[3] ASP stands for *aspect*. *Le*, in this case, is a perfective aspect in Mandarin. For following glosses, CL = *classifier*; Q = *question particle*; DE = *modification marker*; PAR = *particle*.

— Under epistemic modality:
(e.g. epistemic adverbs (7), non-factive epistemic verbs (8), and the inference *le* (9))[4]

(7) **Keneng/xiangbi shei** you qifu ta le
possibly/probably who again bully him ASP
'Possibly/most probably, somebody bullied him again.' (Lin, 1998)

(8) Zhangsan **yiwei/renwei** wo mai-le **shenme**, keshi wo genben mei mai renhe dongxi
Zhangsan think/think I buy-ASP what but I at-all not buy any thing
'Zhangsan thinks that I bought something, but I didn't buy anything at all.' (Li, 1992)

(9) Ta kandao-(le) **shenme le**
he see-ASP$_{\text{perfective}}$ what ASP$_{\text{inchoative}}$
'(It seems that) he saw something.' (Li, 1992)

— In BEFORE-clauses:

(10) **Zai** dui yuangong zuo **shenme zhiqian**, duo kaolu kaolu
at to employee do what before more think think
'You (should) think twice before doing something to the employees.' (Xie, 2007)

— Under imperfective/progressive aspect:

(11) Wo jinqu de shihou, ta **zhengzai** he **shenme**
I enter DE time he ASP$_{\text{progressive}}$ drink what
'When I went in, he was drinking something.' (Xie, 2007)

— In disjunction:

(12) **Yaome shei** lai-guo, **yaome** wo wangji guan chuanghu le
either who come-ASP either I forget close window ASP
'Either somebody came (broke in), or I forgot to close the window.' (Xie, 2007)

— Under deontic modality:

(13) Zhangsan **bixu** mai-***(ge) shenme**
Zhangsan must buy-CL what
'Zhangsan must buy something.'

[4]According to Li (1992), a way of indicating circumstantial inferences in Mandarin is through the sentence-final *le*, which is different from the perefective aspect *le* that attaches to verbs. The sentence-final *le* is often seen as an inchoative *le* that signals a change of state has occurred (Li and Thompson, 1981), and this property correlates with the fact that the inchoative *le* is often used in people's inferential statements.

— In "future" environments: (Lin, 1998)
(e.g. modal verbs (14), imperatives (15), and verb complements (16))

(14) Wo mingtian **hui** qu mai-***(ge) shenme** dongxi song ta
I tomorrow will go buy-CL what thing give him
'I will go to buy something for him tomorrow.'

(15) Guo-lai chi-***(dian) shenme** ba!
come eat-CL what PAR
'Come over to eat something.'

(16) Wo xiawu **dasuan**[5] qu mai-***(ben) shenme** shu lai kan
I this-afternoon plan go buy-CL what book come read
'I plan to buy some book to read this afternoon.'

For convenience, the following table summarizes the overall licensing environments for existential wh-phrases shown above, and a divide is made between the environments based on the obligatory presence of classifiers:

(17) Distributions of existential wh-phrases and classifiers:

No classifiers required:
- Negation
- Polar questions
- Conditionals
- Epistemic modality:
  - ◇ Epistemic adverbs
  - ◇ Non-factive epistemic verbs
  - ◇ Inference *le*
- BEFORE-clauses
- Imperfective/Progressive
- Disjunction

classifiers required:
- Future environment:
  - ◇ Deontic modality
  - ◇ Imperatives
  - ◇ Verbs with future-event-denoting complements

2. The classifier puzzles

Given the distribution of classifiers in the licensing environments of existential wh-phrases, we can roughly frame our first classifier puzzle as follows:

(18) Classifier puzzle #1:
Why does an existential wh-phrase require a classifier only in certain environments?

[5] The complement of verbs like *dasuan* ('plan') typically refer to actions in the future (Lin, 1998).

Another classifier puzzle concerns an observation made by Liao (2011), where the requirement of classifiers in the deontic environment can be lifted when the environment is embedded under an epistemic one:

(19) Zhangsan **haoxiang bixu** mai-**(ge) shenme**
Zhangsan seem must buy-CL what
'It seems that Zhangsan must buy something.' (Liao, 2011)

Thus, we may ask:

(20) Classifier puzzle #2:
Why is the classifier no longer needed in the above situation?

The next section is dedicated to developing an analysis that aims to tackle these puzzles by implementing classifiers into the licensing mechanism for Mandarin existential wh-phrases.

3. Analysis

Contra Huang (1982), this paper adopts the point of view that wh-phrases are inherently non-quantificational and acquire their quantificational force externally (Cheng, 1991; Tsai, 1999, 2003, 2010). They are analyzed as denoting sets of alternatives under Hamblin (1973) style semantics, following Kratzer and Shimoyama's (2002) treatment of Japanese indeterminate pronouns, as well as Li and Law's (2014) treatment of Mandarin wh-phrases:[6]

(21) a. $[\![$**shenme** ('what')$]\!]^{w,\,g} = \{x_e : \text{thing}_w(x)\} \in D_{\langle e\rangle/t}$[7]
b. $[\![$**shei** ('who')$]\!]^{w,\,g} = \{y_e : \text{person}_w(y)\} \in D_{\langle e\rangle/t}$

If the denotations of wh-phrases percolate up to the CP level via Pointwise Function Application (Yatsushiro, 2009), we will get the denotations of wh-questions, where each wh-question denotes a set of propositions. In order for a wh-phrase to be interpreted as existential, the set of propositions has to be captured by a sentential ∃, existentially closing the set (Kratzer and Shimoyama, 2002; pg. 7):

(22) For $[\![\alpha]\!]^{w,\,g} \subseteq D_{\langle st\rangle} : [\![\exists\alpha]\!]^{w,\,g} = \{\lambda w'\,.\, \exists p\, [p \in [\![\alpha]\!]^{w,\,g} \,\&\, p(w') = 1]\}$

Classifiers are hypothesized to be serving the role of ∃ within the domain of *v*P. Reasons for this hypothesis will be made clear later, but it is important to note that the existential closure of wh-phrases (either by the covert ∃ or by a classifier) is not without conditions. We simply cannot close the sets denoted by wh-phrases anywhere, given the following sentence:

[6] The motivation for Li and Law's (2014) treatment of Mandarin wh-phrases as sets of alternatives comes from the intervention effects when a focus operator like *zhiyou* ('only') enters certain hierarchical configurations with the wh-phrase.

[7] The type ⟨e⟩/t is the type of sets of alternatives defined in Yatsushiro (2009). The semantic composition of wh-phrases in this paper follows Yatsushiro's (2009) system, where wh-phrases compose via Pointwise Function Application and end up generating sets of propositions, i.e. the denotation of wh-questions.

(23) Zhangsan zuotian chi-le-**(ge)** **shenme**
Zhangsan yesterday eat-ASP-CL what
'What did Zhangsan eat yesterday?' / *'Zhangsan ate something yesterday.'

Even in the presence of a classifier, the wh-phrase in (23) can only be interpreted as an interrogative rather than an existential. Therefore, we also need to factor in all and only the environments where the existential reading is found. Given the nature of the licensing environments in the introduction, Xie (2007) and Lin et al. (2014) propose *non-veridicality* in the sense of Zwarts (1995) as the licensing condition for Mandarin existential wh-phrases:

(24) (Non-)veridicality for propositional operators:
A propositional operator F is veridical iff Fp entails p: $Fp \vDash p$; otherwise, F is non-veridical. (Lin, Weerman, and Zeijlstra, 2014)

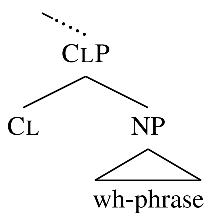
All of the boldfaced items (other than the wh-phrases) in (4) to (16) can be viewed as a non-veridical operator under the definition above,[8]leaving aside the case of imperatives, which has no overt operators though non-veridical in nature.

Taking the environmental factor into account, I propose the following licensing conditions for Mandarin existential wh-phrases that connect $\exists$ and non-veridicality:

(25) General licensing conditions for existential wh-phrases:
a. Non-veridicality:
A wh-phrase can only be grammatical under an existential reading when closed by $\exists$ in a non-veridical environment (i.e. in the scope of a non-veridical operator).
b. Existential closure:
(i) $\exists$ applies higher than *v*P with the following semantics:
$[\![\exists]\!]^{w,\,g} = \lambda\alpha_{\langle st\rangle/t}\lambda w'\,.\ \exists p\,[p \in \alpha \wedge p(w') = 1]$
($\langle st\rangle/t$ being the type of sets of propositions)
(ii) A classifier can close the set denoted by its argument wh-phrase:[9]
$[\![\text{CL}_\exists]\!]^{w,\,g} = \lambda\alpha_{\langle e\rangle/t}\lambda P_{\langle e,\,est\rangle/t}\lambda y\lambda w'\,.\ \exists z\,[z \in \alpha \wedge P_{w'}(z)(y) = 1]$

[8]One might wonder why the *imperfective/progressive* aspect is viewed as non-veridical. According to Xie (2007), who follows Giannakidou (2002) in defining non-veridicality over temporal relations denoted by aspectual operators, an aspectual operator is veridical iff the topic time strictly follows the time of the resultant state of an eventuality the aspectual operator is predicated of. Otherwise, the aspectual operator is non-veridical. Since under the *imperfective/progressive* aspect the topic time is included in the event time of an eventuality (of which the time of resultant state is a part), the *imperfective/progressive* aspect is therefore non-veridical.

[9]This application assumes the structure proposed in Cheng and Sybesma (1999, 2005) for Mandarin nominals, where the classifier is a functional head CL(ASSIFIER) that forms a constituent with the wh-phrase following it:

(i)


Although rather stipulative, we need the condition of non-veridicality in (25a) to rule out sentences like (23), where the wh-phrase could potentially be existentially closed by ∃ or a classifier. Moreover, once we factor in the positions of the non-veridical operators, the condition in (25a) and the hypothesis that ∃ applies higher than *v*P (25b) can help us account for the environment-dependent co-occurrence of the wh-phrase and classifiers, which will be the focus of the next section.

This analysis also makes predictions about the scope of the wh-phrase, depending on where it is existentially closed. It will be shown that the predictions are borne out after establishing the syntactic positions of the non-veridical operators and their interactions with ∃.

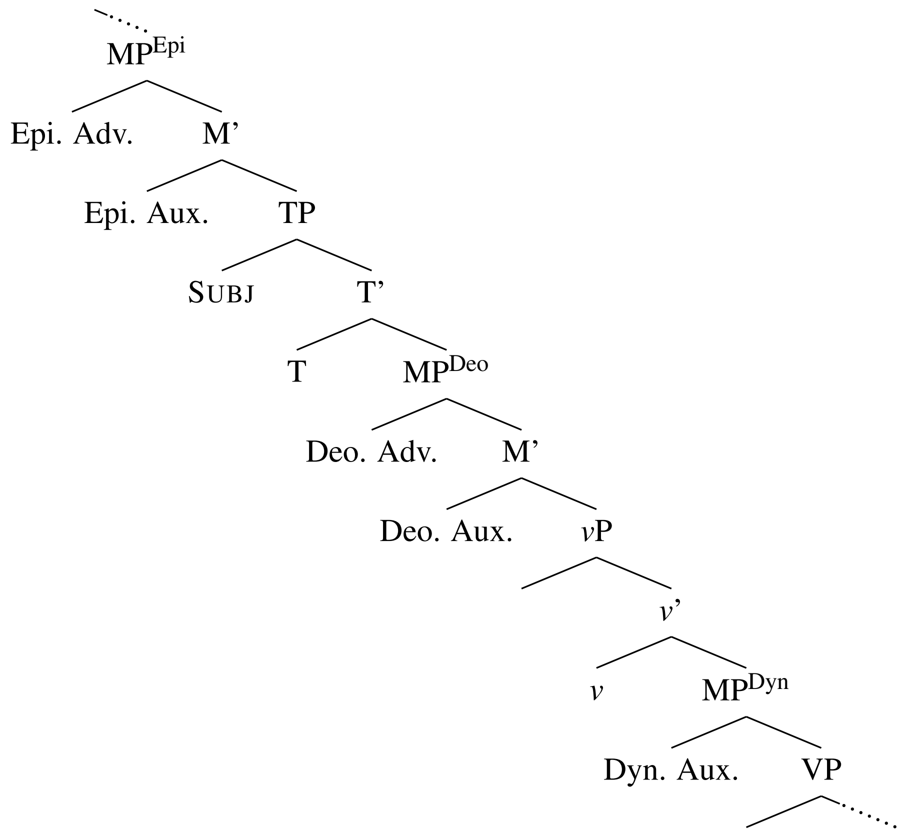
3.1. Application of ∃

The account for the classifier requirement in existential wh-phrase licensing will resort to the interaction between the non-veridical operators and the application site of ∃. The licensing reasoning goes as follows: (i) A wh-phrase has to be existentially closed within a non-veridical domain, (25a). (ii) ∃ applies higher than *v*P, (25b), contrary to the common assumption that it applies low at VP (Diesing, 1990, 1992). (iii) If the non-veridical operator is no higher than *v*P, existentially closing the wh-phrase would be ungrammatical, i.e. a violation of (25a). (iv) In that case, a classifier comes in as a replacement for ∃ (hence the hypothesis that classifiers serve as ∃ within the domain of *v*P).

Given this reasoning, we are in other words saying that the environments where classifiers are required are environments where the non-veridical operators scope lower than ∃. This statement can be corroborated by the clausal structure in Tsai (2010), where different types of modals assume different syntactic heights:[10]

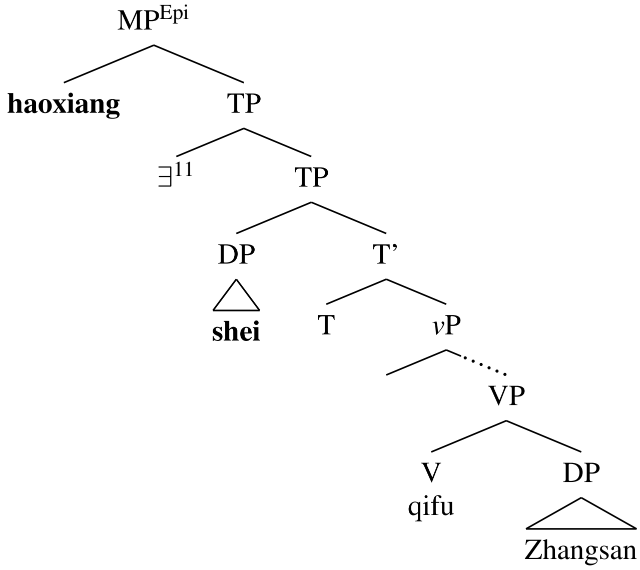
[10]Tsai (2010) reaches this structure after investigating the syntactic and scope interactions between the different types of modals (i.e. epistemic, deontic, and dynamic modals). His argument is not presented here due to reasons of space. For a detailed argument for this structure, I refer the readers to Tsai (2010).

(26)



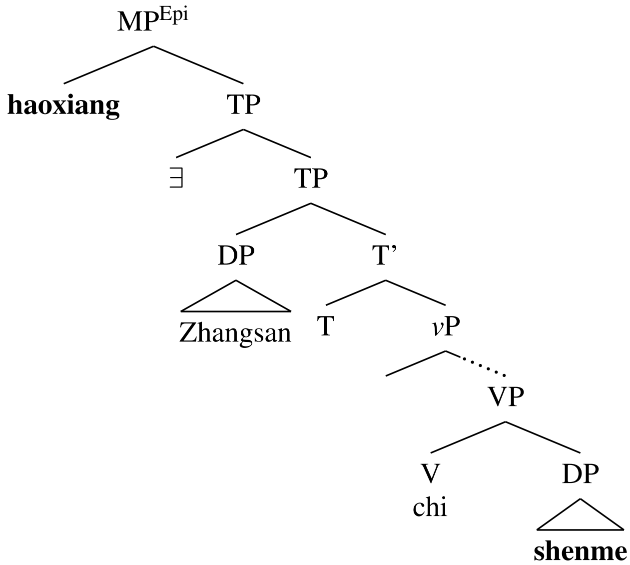
Given the positional difference between the epistemic and deontic modals, whose scopes constitute the licensing domains for existential wh-phrases, we can now explain the contrast between the epistemic and deontic environments in terms of the classifier requirement:

(27) **Haoxiang shei** qifu-le Zhangsan
seem who bully-ASP Zhangsan
'It seems that somebody bullied Zhangsan.'
$[_{TP_3}$ **haoxiang** $[_{TP_2}\ \exists\ [_{TP_1}$ **shei**$_i$ $[_{vP}\ t_i\ [_{VP}$ qifu-le Zhangsan]]]]]



$[\![(27)]\!]^{w,\,g} = \exists w'' \in \mathscr{M}_{(w,\ epistemic)}\ .\ \exists p\ [p \in \{\lambda w'\ .\ bully_{w'}(y, ZS) \mid person_w(y)\} \wedge p(w'') = 1]$[12]

(28) Zhangsan **haoxiang** chi-le **shenme**
Zhangsan seem eat-ASP what
'It seems that Zhangsan ate something.'
$[_{TP_3}$ **haoxiang** $[_{TP_2}\ \exists\ [_{TP_1}$ Zhangsan$_i$ $[_{vP}\ t_i\ [_{VP}$ chi-le **shenme**]]]]]



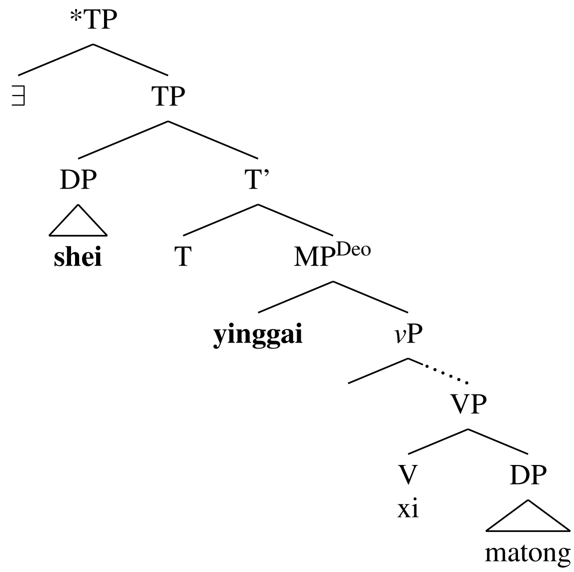
$[\![(28)]\!]^{w,\,g} = \exists w'' \in \mathscr{M}_{(w,\ epistemic)}\ .\ \exists p\ [p \in \{\lambda w'\ .\ eat_{w'}(ZS, x) \mid thing_w(x)\} \wedge p(w'') = 1]$

[11] The covert existential closure $\exists$ is put in Spec.TP in the structure of (27). This is a position where it can compose with the TP of type $\langle st\rangle/t$ given its semantics. However, it is not limited to being in this position. It can be in any position where its argument's type allows it to compose, as long as that position is higher than *v*P.

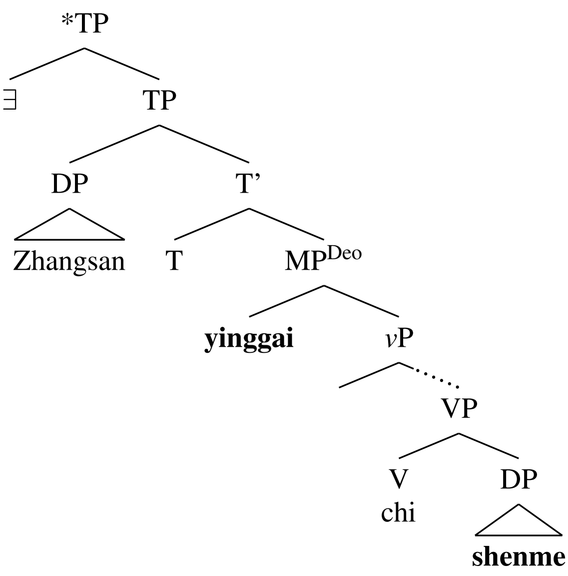
[12] For a thorough derivation of the semantics of the current and following examples, please see the appendix.

The epistemic modal is a sentential operator whose non-veridical licensing domain for the wh-phrase encompasses the application site of ∃. Therefore, the wh-phrase can be closed by ∃ and interpreted as an existential, following the condition in (25a). On the other hand, the deontic modal scopes low (at *v*P) and ∃ falls outside of its non-veridical domain. As a result, the wh-phrase, be it a subject or an object, cannot be closed by ∃ and obtain the existential reading:

(29) **Shei yinggai** xi matong
who should wash toilet
*'Somebody should wash the toilet.' / 'Who should wash the toilet?'
*[$_{\text{TP}_2}$ ∃ [$_{\text{TP}_1}$ **shei**$_i$ [$_{v\text{P}_2}$ **yinggai** [$_{v\text{P}_1}$ t$_i$ [$_{\text{VP}}$ xi matong]]]]]



(30) Zhangsan **yinggai** chi **shenme**
Zhangsan should eat what
*'Zhangsan should eat something.' / 'What should Zhangsan eat?'
*[$_{\text{TP}_2}$ ∃ [$_{\text{TP}_1}$ Zhangsan$_i$ [$_{v\text{P}_2}$ **yinggai** [$_{v\text{P}_1}$ t$_i$ [$_{\text{VP}}$ chi **shenme**]]]]]



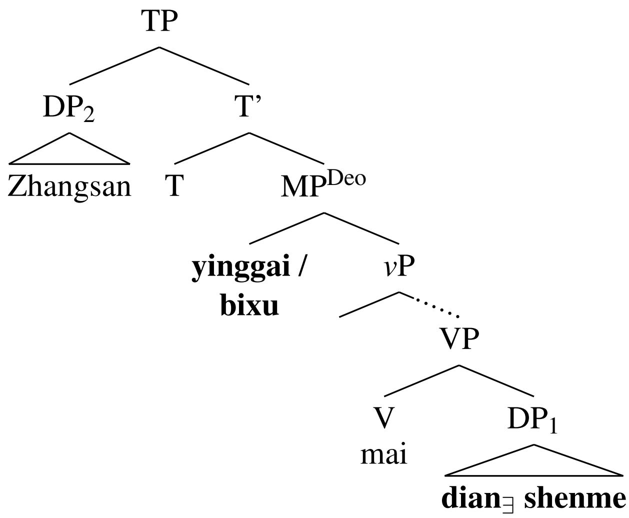
Due to the unavailability of ∃, the set of alternatives denoted by the wh-phrase cannot be existentially closed but has to percolate up, leading to the obligatory interrogative reading, i.e. the reading of a wh-question.

3.2. Classifiers as ∃

The only way for the wh-phrase to be existential in this case of low-scoping non-veridical operators is for the classifier to take over the job of ∃ and close the set denoted by the wh-phrase with the semantics proposed in (25bii), repeated here as (31a):

(31) a. $[\![\text{CL}_{\exists}]\!]^{w,\,g} = \lambda\alpha_{\langle e\rangle/t}\lambda P_{\langle e,\, est\rangle}\lambda y\lambda w'\,.\,\exists z\,[z \in \alpha \wedge P_{w'}(z)(y) = 1]$[13]

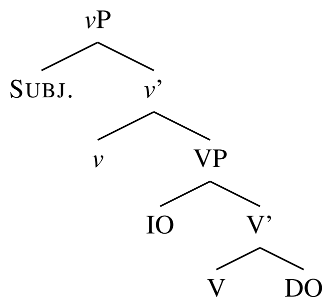
b. Zhangsan **yinggai/bixu** mai-**dian shenme**
Zhangsan should/must buy-CL what
'Zhangsan should/must buy something.'
$[_{TP}$ Zhangsan$_i$ $[_{vP_2}$ **yinggai/bixu** $[_{vP_1}$ t_i $[_{VP}$ mai-**dian**$_{\exists}$ **shenme** $]]]]$



$[\![\textbf{shenme}]\!]^{w,\,g} = \{x_e : \text{thing}_w(x)\}$
$[\![DP_1]\!]^{w,\,g} = \lambda P_{\langle e,\, est\rangle}\lambda y\lambda w'\,.\,\exists z\,[z \in \{x_e : \text{thing}_w(x)\} \wedge P_{w'}(z)(y) = 1]$
$[\![(31b)]\!]^{w,\,g} = \forall w'' \in \mathscr{M}_{(w,\,\text{deontic})}\,.\,\exists z\,[z \in \{x_e : \text{thing}_w(x)\} \wedge \text{buy}_{w''}(ZS, z) = 1]$

[13] The denotation proposed for classifiers as ∃ may seem too restrictive since its second argument position assumes a predicate of type ⟨e, est⟩, i.e. the type of transitive verbs. However, we can allow for slight variation of the denotation between those in (ii), assuming the verbal structure proposed by Huang, Li, and Li (2009) in (i):

(i)

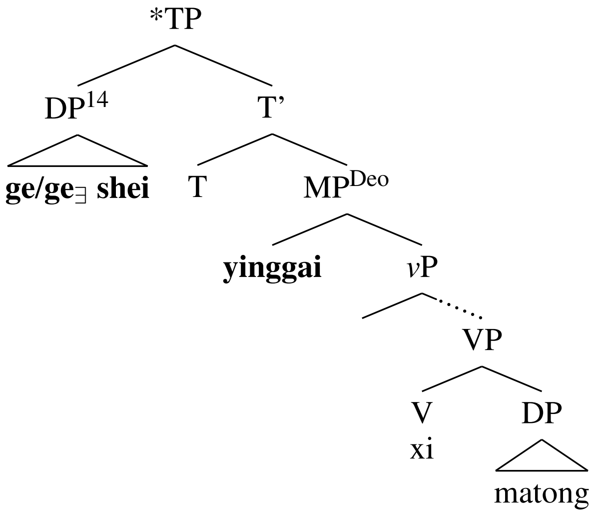


However, if what we have in the case of low-scoping deontic modals is a wh-subject as in (29), inserting a classifier before the wh-subject would not help for two reasons: (i) the wh-subject falls outside of the non-veridical licensing domain (i.e. outside of the scope of the deontic modals), and (ii) Mandarin classifiers are clitic-like items that usually need to attach to numerals, demonstratives, or verbs, and cannot stand alone sentence-initially:

(32) ***Ge ren** xihuan Zhangsan
CL person like Zhangsan
'Somebody likes Zhangsan.'

The clitic need of classifiers thus makes sentences with a [CL + Wh] subject ungrammatical, even under an interrogative reading:

(33) ***Ge shei** yinggai xi matong
CL who should wash toilet
*'Somebody should wash the toilet.' / *'Who should wash the toilet?'
*[$_{TP}$ [$_{DP}$ **ge/ge$_{\exists}$ shei**]$_i$ [$_{vP_2}$ **yinggai** [$_{vP_1}$ t$_i$ [$_{VP}$ xi matong]]]]



If we try to generalize the contrast between the epistemic and deontic modals under discussion to other licensing environments, we can see that generally speaking, the requirement of classi-

(ii) For [CL + Wh] direct objects (DOs),
$$[\![\text{CL}_{\exists}]\!]^{w,g} = \lambda\alpha_{\langle e\rangle/t}\lambda P_{\langle e,\langle e,\, est\rangle\rangle}\lambda x\lambda y\lambda w'\,.\,\exists z\,[z \in \alpha \wedge P_{w'}(z)(x)(y) = 1]$$
For [CL + Wh] indirect objects (IOs),
$$[\![\text{CL}_{\exists}]\!]^{w,g} = \lambda\alpha_{\langle e\rangle/t}\lambda P_{\langle e,\, est\rangle}\lambda y\lambda w'\,.\,\exists z\,[z \in \alpha \wedge P_{w'}(z)(y) = 1] = (31a)$$

Please note that when CL$_{\exists}$ shows up with a wh-phrase as the indirect object, the denotation for CL$_{\exists}$ remains the same as in the case of transitive verbs, because the first argument position in the denotation of the di-transitive verb will have been saturated by the direct object before the verb composes with the [CL$_{\exists}$ + Wh] IO.

[14] As will be clear in later sections, Mandarin classifiers assume two types of functions, that of regular classifiers (i.e. those that go with regular NPs) and that of $\exists$ (as in the case of existential wh-phrases). The two types are differentiated by the $\exists$ subscript on the classifier: CL$_{\exists}$ closes the set of alternatives denoted by the wh-phrase and renders it existential while CL is transparent to the set denotations of wh-phrases and the DP [CL + Wh] remains a wh-interrogative.

fiers can be seen as a reflection of high vs. low non-veridical operators. All of the non-veridical operators that do not require a classifier in their scope to license an existential wh-phrase are sentential (or not sentential but higher than *v*P as in the case of the imperfective/progressive aspect), or can embed structures bigger than a *v*P (e.g. non-factive epistemic verbs). Classifiers are needed elsewhere; that is, under the operators that are not higher than a *v*P (e.g. deontic modals) or cannot embed structures larger than a *v*P (e.g. the *future* verbs, which cannot embed a full finite TP). Our first puzzle concerning the environment-dependent requirement of classifiers is thus solved.

4. Classifier distribution

Having established the licensing mechanism for Mandarin existential wh-phrases, we can now also explain our second classifier puzzle, where the classifier that was once required under a deontic modal is no longer needed when the deontic modal is further embedded under an epistemic modal:

(34) Zhangsan **haoxiang bixu** mai-**(ge) shenme**
Zhangsan seem must buy-CL what
'It seems that Zhangsan must buy something.'
[$_{TP_3}$ **haoxiang** [$_{TP_2}$ $\exists$ [$_{TP_1}$ Zhangsan$_i$ [$_{vP_2}$ **bixu** [$_{vP_1}$ t$_i$ [$_{VP}$ mai-(<u>**ge**$_\exists$</u>) **shenme**]]]]]]

As shown by the LF above, the epistemic modal expands the licensing domain of the wh-phrase from the *v*P to the sentential level to include the high $\exists$, providing another option of existential closure for the wh-phrase. As a result, the classifier is no longer necessary for the existential reading. The second classifier puzzle is also solved.

Given the way the current account is set up, it makes a prediction that if we expand the licensing domain of the wh-phrase by embedding a classifier-requiring environment under a non-classifier-requiring one, we can remove the need of a classifier for licensing the wh-phrase. The following examples show that this prediction is indeed borne out:[15]

(35) Zhangsan **hui** qu mai-**(xie) shenme** dongxi song ta **ma**?
Zhangsan will go buy-CL what thing give him Q
'Will Zhangsan go to buy something for him?'
[$_{CP}$ [$_{TP_2}$ $\exists$ [$_{TP_1}$ Zhangsan **hui** qu mai-(<u>**xie**$_\exists$</u>) **shenme** dongxi song ta]] **ma**]?

[15] The existential interpretation of the wh-subject in the case of low non-veridical operators (e.g. deontic modals) that was non-rescuable by the insertion of a classifier can now be rescued under embedding, as predicted, given the availability of $\exists$ made by domain expansion. Example (29) embedded under the polar question particle *ma* is shown here for illustration:

(i) **Shei yinggai** xi matong **ma**?
who should wash toilet Q
'Should somebody wash the toilet?'
[$_{CP}$ [$_{TP_2}$ $\exists$ [$_{TP_1}$ **Shei**$_i$ [$_{vP_2}$ **yinggai** [$_{vP_1}$ t$_i$ [$_{VP}$ xi matong]]]]] **ma**]?

(36) **Yaoshi** Zhangsan **bixu** chi-**(dian) shenme**, qing gaosu wo
if Zhangsan must eat-CL what please tell me
'If Zhangsan must eat something, please tell me.'
[$_{\text{TP}_2}$ **yaoshi** $\exists$ [$_{\text{TP}_1}$ Zhangsan **bixu** chi-(**dian**$_{\exists}$) **shenme**, ...]]

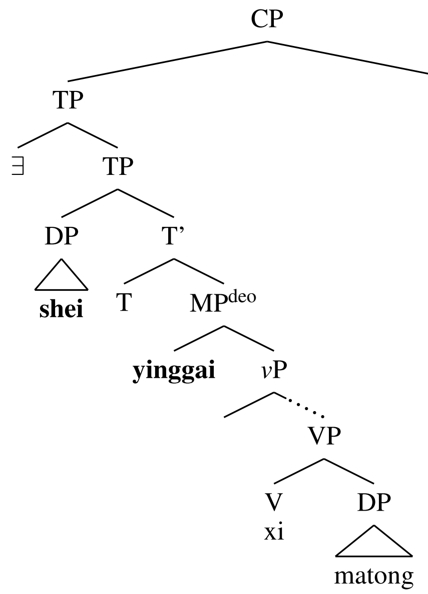
(37) Wo **yiwei** Zhangsan **dasuan** zhao-**(ge) shei** lai bangang
I think Zhangsan plan find-CL who come help
'I thought Zhangsan planned to find somebody to help.'
[$_{\text{TP}_3}$ Wo **yiwei** [$_{\text{CP}}$ [$_{\text{TP}_2}$ $\exists$ [$_{\text{TP}_1}$ Zhangsan **dasuan** zhao-(**ge**$_{\exists}$) **shei** ...]]]]

Above are three instances of non-veridical operators that require a classifier in their scope (a modal verb **hui** ('will') in (35), a deontic modal **bixu** ('must') in (36), and a *future* verb **dasuan** ('plan') in (37)) being embedded under operators that do not (the polar question particle **ma** in (35), a conditional morpheme **yaoshi** ('if') in (36), and a non-factive epistemic verb **yiwei** ('think') in (37)). And the classifiers are now optional in all of the instances.

5. Scope of wh-phrases

The issue about what options of existential closure are available to the wh-phrase makes another prediction about the scope interpretation of the wh-phrase. In the examples shown above, we should have scope ambiguity of the wh-phrase, depending on what it is closed by in its licensing domain. And we do indeed find scope ambiguity in cases like those:

(38) Zhangsan **haoxiang bixu** chi-**dian shenme**
Zhangsan seem must eat-CL what
'It seems that Zhangsan must eat something.' (*seem* > *must* > CL$_{\exists}$)
'It seems that there is something such that Zhangsan must eat it.' (*seem* > $\exists$ > *must*)



The scope ambiguity exists under the assumption that classifiers only serve as ∃ in the case of existential wh-phrase licensing when needed. In other words, they do not necessarily close the set denoted by the wh-phrase if the higher covert ∃ is also available. Consequently, the wh-phrase has two options of existential closure given the domain expansion by the epistemic modal, leading to the scenario where the two options of existential closure fall on either side of the low non-veridical operator (i.e. the deontic modal). Hence, the wide and narrow scope reading of the wh-phrase with respect to the low non-veridical operator are both accessible.

Given the presence of the classifier in (38) and the possibility of obtaining a wide scope reading of the wh-phrase, we are in a way saying that classifiers are ambiguous between ∃ and regular classifiers so that the set denotation of the wh-phrase can percolate up the structure and be closed by the higher ∃ in the latter case.[16] This is a necessary hypothesis to make, given how the licensing mechanism is constructed: Existentially closing the wh-phrase in environments other than non-veridical would result in ungrammaticality. However, the following sentence is grammatical, but only with an interrogative reading of the wh-phrase:

(39) Zhangsan tingdao-le-**xie shenme**
Zhangsan hear-ASP-CL what
*'Zhangsan heard something.' / 'What did Zhangsan hear?'

Furthermore, in the absence of a classifier in environments like (38), the wh-phrase is predicted to be non-ambiguous and have only wide scope with respect to the low non-veridical operator, which is attested by the following example:

(40) Zhangsan **haoxiang bixu** chi **shenme**
Zhangsan seem must eat what
'It seems that Zhangsan must eat something.' ($seem > must >$ CL$_{\exists}$)
'It seems that there is something such that Zhangsan must eat it.' ($seem > \exists > must$)

It is the higher covert ∃ that is existentially closing the wh-phrase in this case under the licensing domain of the high non-veridical operator. Given the application site of ∃, i.e. higher than *v*P, the wh-phrase necessarily has wide scope with respect to the low non-veridical operator.

[16]According to Cheng and Sybesma (1999, 2005), from whom I adopt the structure of Mandarin nominals, the function of the CL head is the ι operator that renders the definite reading of the NP it composes with. Apparently, our analysis of wh-phrases as denoting sets of alternatives would not be able to compose with a regular classifier if we follow Cheng and Sybesma's analysis. Therefore, we need to propose another denotation for the classifier so that it can compose with a wh-phrase and pass up the wh-phrase's set denotation:

(i) $[\![\text{CL}_{\text{wh}}]\!]^{w,g} = \lambda f_{\langle e \rangle /t} \, . \, f$

The classifier in this case is treated as denoting an identity function whose first argument is a set of alternatives. This denotation guarantees the exclusive relationship between this type of regular classifiers and wh-phrases (as opposed to the ι-classifier with regular NPs), as well as the derivation of the interrogative reading of a wh-question as in (39).

6. Conclusion

To conclude, the analysis of licensing Mandarin existential wh-phrases presented in this paper builds on two major factors that make necessary conditions for the existential interpretation of wh-phrases: Non-veridicality and existential closure (∃). By attributing the role classifiers play in the licensing mechanism to fulfilling the function of ∃ when ∃ is unavailable, we are able to account for the distribution of classifiers that is environment-dependent. The (un-) availability of ∃ is conditioned by two other factors: The application site of ∃, i.e. above *v*P, and the syntactic heights of non-veridical operators that license the wh-phrase. Given our hypothesis that a wh-phrase can only be grammatically closed by ∃ in a non-veridical domain, classifiers are required to take over the job of ∃ when the licensor of the wh-phrase is a low non-veridical operator, outside of whose scope ∃ falls. Thus, the distribution of classifiers in the case of existential wh-phrases is licensor-related, i.e. their environment-dependent nature, and their obligatory presence can be made optional under the expansion of the non-veridical licensing domain by embedding a low licensor below a high licensor to include the covert ∃ that was once out of reach. And the availability of both means of existential closure in this case renders the wh-phrase scope ambiguous, which is also proven true in this paper.

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Appendix. Semantic derivations of existential wh-phrases

The proposed denotations for Mandarin wh-phrases:

(i) $[\![$**shenme** (‘what’)$]\!]^{w,\,g} = \{x_e : \text{thing}_w(x)\} \in D_{\langle e\rangle/t}$

(ii) $[\![$**shei** (‘who’)$]\!]^{w,\,g} = \{y_e : \text{person}_w(y)\} \in D_{\langle e\rangle/t}$

Yatsushiro’s (2009) definition of Pointwise Functional Application:

(iii) Semantic types of alternative sets (Yatsushiro, 2009; pg. 152)
For any type α; α/t is the type of sets of entities of type α, $D_{\alpha/t} = \text{POW}(D_\alpha)$

(iv) Pointwise Functional Application (Yatsushiro, 2009; pg. 153):
If X is a phrase with two immediate subconstituents Y and Z, then $[\![X]\!]^g$ is defined as follows:

. . . .

if $[\![Y]\!]^g$ is of type α; $[\![Z]\!]^g$ is of type $\langle\alpha, \beta\rangle$, then $[\![X]\!]^g = [\![Z]\!]^g([\![Y]\!]^g) \in D_\beta$;

. . . .

if $[\![Y]\!]^g$ is of type α/t; $[\![Z]\!]^g$ is of type $\langle\alpha, \beta\rangle$, then $[\![X]\!]^g = \{[\![Z]\!]^g(y) \mid y \in [\![Y]\!]^g\} \in D_{\beta/t}$;

. . . .

if $[\![Y]\!]^g$ is of type α; $[\![Z]\!]^g$ is of type $\langle\alpha, \beta\rangle/t$, then $[\![X]\!]^g = \{z([\![Y]\!]^g) \mid z \in [\![Z]\!]^g\} \in D_{\beta/t}$;

. . . .

if $[\![Y]\!]^g$ is of type α/t; $[\![Z]\!]^g$ is of type $\langle\alpha, \beta\rangle/t$,
then $[\![X]\!]^g = \{z(y) \mid z \in [\![Z]\!]^g \text{ and } y \in [\![Y]\!]^g\} \in D_{\beta/t}$

. . . .

Semantic derivation of (27):

(27) **Haoxiang shei** qifu-le Zhangsan
seem who bully-ASP Zhangsan
‘It seems that somebody bullied Zhangsan.’
$[_{TP_3}$ **haoxiang** $[_{TP_2} \exists\ [_{TP_1}$ **shei**$_i$ $[_{vP}\ t_i\ [_{VP}$ qifu-le Zhangsan $]]]]]$

$[\![\textit{Zhangsan}]\!]^{w,\,g} = \textit{Zhangsan} \in D_e$

$[\![\textit{qifu}]\!]^{w,\,g} = \lambda x \lambda y \lambda w’ .\ \text{bully}_{w’}(y, x) \in D_{\langle e,\langle e,\, st\rangle\rangle}$

$[\![vP]\!]^{w,\,g} = \lambda y \lambda w’ .\ \text{bully}_{w’}(y, ZS) \in D_{\langle e,\, st\rangle}$

$[\![TP_1]\!]^{w,\,g} = \{\lambda w’ .\ \text{bully}_{w’}(y, ZS) \mid \text{person}_w(y)\} \in D_{\langle s\rangle/t}$

$[\![\exists]\!]^{w,\,g} = \lambda \alpha_{\langle st\rangle/t} \lambda w” .\ \exists p\ [p \in \alpha \wedge p(w”) = 1]$

$[\![TP_2]\!]^{w,\,g} = \lambda w” .\ \exists p\ [p \in \{\lambda w’ .\ \text{bully}_{w’}(y, ZS) \mid \text{person}_w(y)\} \wedge p(w”) = 1] \in D_{\langle st\rangle}$

$[\![\textit{haoxiang}]\!]^{w,\,g} = \lambda P .\ \exists w”’ \in \mathscr{M}_{(w,\ \text{epistemic})} .\ P(w”’) = 1$

$[\![TP_3]\!]^{w,\,g} = \underline{\exists w”’ \in \mathscr{M}_{(w,\ \text{epistemic})} .\ \exists p\ [p \in \{\lambda w’.\ \text{bully}_{w’}(y, ZS) \mid \text{person}_w(y)\} \wedge p(w”’) = 1]}$

Semantic derivation of (28):

(28) Zhangsan **haoxiang** chi-le **shenme**
Zhangsan seem eat-ASP what
'It seems that Zhangsan ate something.'
$[_{TP_3}$ **haoxiang** $[_{TP_2}\ \exists\ [_{TP_1}$ Zhangsan$_i$ $[_{vP}\ t_i\ [_{VP}$ chi-le **shenme**]]]]]

$[\![chi]\!]^{w,\,g} = \lambda x \lambda y \lambda w'\ .\ eat_{w'}(y, x) \in D_{\langle e,\langle e,\, st\rangle\rangle}$
$[\![vP]\!]^{w,\,g} = \{\lambda y \lambda w'\ .\ eat_{w'}(y, x) \mid thing_w(x)\} \in D_{\langle e,\, st\rangle/t}$
$[\![TP_1]\!]^{w,\,g} = \{\lambda w'\ .\ eat_{w'}(ZS, x) \mid thing_w(x)\} \in D_{\langle st\rangle/t}$
$[\![\exists]\!]^{w,\,g} = \lambda \alpha_{\langle st\rangle/t} \lambda w''\ .\ \exists p\ [p \in \alpha \wedge p(w'') = 1]$
$[\![TP_2]\!]^{w,\,g} = \lambda w''\ .\ \exists p\ [p \in \{\lambda w'\ .\ eat_{w'}(ZS, x) \mid thing_w(x)\} \wedge p(w'') = 1] \in D_{\langle st\rangle}$
$[\![haoxiang]\!]^{w,\,g} = \lambda P\ .\ \exists w''' \in \mathscr{M}_{(w,\ epistemic)}\ .\ P(w''') = 1$
$[\![TP_3]\!]^{w,\,g} = \underline{\exists w''' \in \mathscr{M}_{(w,\ epistemic)}\ .\ \exists p\ [p \in \{\lambda w'\ .\ eat_{w'}(ZS, x) \mid thing_w(x)\} \wedge p(w''') = 1]}$

Semantic derivation of (31b):

(31b) Zhangsan **bixu** mai-**dian shenme**
Zhangsan must buy-CL what
'Zhangsan must buy something.'
$[_{TP}$ Zhangsan$_1$ 1 $[_{vP_2}$ **bixu** $[_{vP_1}\ t_1\ [_{VP}$ mai $[_{DP}$ **dian**$_\exists$ **shenme**]]]]]

$[\![dian_\exists]\!]^{w,\,g} = \lambda \alpha_{\langle e\rangle/t} \lambda P_{\langle e,\langle e,\, st\rangle\rangle} \lambda y \lambda w'\ .\ \exists z\ [z \in \alpha \wedge P_{w'}(z)(y) = 1]$
$[\![DP]\!]^{w,\,g} = \lambda P_{\langle e,\langle e,\, st\rangle\rangle} \lambda y \lambda w'\ .\ \exists z\ [z \in \{x : thing_w(x)\} \wedge P_{w'}(z)(y) = 1]$
$[\![mai]\!]^{w,\,g} = \lambda x \lambda y \lambda w''\ .\ buy_{w''}(y, x) \in D_{\langle e,\langle e,\, st\rangle\rangle}$
$[\![VP]\!]^{w,\,g} = \lambda y \lambda w'\ .\ \exists z\ [z \in \{x_e : thing_w(x)\} \wedge buy_{w'}(y, z) = 1] \in D_{\langle e,\, st\rangle}$
$[\![vP_1]\!]^{w,\,g} = \lambda w'\ .\ \exists z\ [z \in \{x_e : thing_w(x)\} \wedge buy_{w'}(g(1), z) = 1] \in D_{\langle st\rangle}$
$[\![bixu]\!]^{w,\,g} = \lambda P\ .\ \forall w''' \in \mathscr{M}_{(w,\ deontic)}\ .\ P(w''') = 1$
$[\![vP_2]\!]^{w,\,g} = \forall w''' \in \mathscr{M}_{(w,\ deontic)}\ .\ \exists z\ [z \in \{x_e : thing_w(x)\} \wedge buy_{w'''}(g(1), z) = 1]$
$[\![1\ vP_2]\!]^{w,\,g} = \lambda y\ .\ \forall w''' \in \mathscr{M}_{(w,\ deontic)}\ .\ \exists z\ [z \in \{x_e : thing_w(x)\} \wedge buy_{w'''}(y, z) = 1]$
$[\![TP]\!]^{w,\,g} = \underline{\forall w''' \in \mathscr{M}_{(w,\ deontic)}\ .\ \exists z\ [z \in \{x_e : thing_w(x)\} \wedge buy_{w'''}(ZS, z) = 1]}$

Composing discourse parenthetical reports[1]

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Abstract. Hunter (2016) proposed that a speech report with a parenthetical interpretation but non-parenthetical syntax will contribute a modal discourse relation of the form $\Diamond$R to discourse logical form. This paper provides a compositional account of the mechanism by which these modal relations are triggered. It then extends Hunter's proposal to reports involving factive embedding verbs and provides an explanation of why explicit discourse connectives sometimes block parenthetical readings of reports in their scope.

Keywords: coercion, discourse connectives, discourse structure, factive verbs, parenthetical reports, speech reports

1. Introduction

As observed in Simons (2007) and Urmson (1952) *inter alia*, sometimes the main point of a speech or attitude report is conveyed by the embedded clause alone. Compare (1) and (2):

(1) a. Liz is sad.
b. **A famous critic said that her new album isn't worth a dime**.

(2) a. John didn't come to my party.
b. Jill said that **he was out of town**.

In both (1) and (2), (b) is naturally understood as offering an explanation of the content of (a); the intuitive explanantia are in bold. In (1), it is the fact that the critic said what she did that explains why Liz is upset; in other words, the entire report contributes to the explanation. On the most natural reading of (2), however, the embedded clause of (2b) alone contributes to the explanation; the fact that Jill said what she did plays a backgrounded, evidential role.

Urmson (1952) called uses of embedding verbs like that in (2) *parenthetical*. In these uses, embedding verbs play a secondary role, apparently serving to provide evidence for, or qualification of, the reported content. In this way, they resemble verbs of speech or attitude in the slifted clauses (Ross, 1973) of syntactically parenthetical reports such as (3).

(3) He was out of town, Jill said.

Despite the similarity between (2b) and (3), we will assume that (2b) has a parenthetical reading (because *say* has a parenthetical reading) but non-parenthetical syntax. That is, following Simons (2007), we will assume that in (2b), the content expressed by the clause in bold falls in the scope of the embedding verb *say*, as the surface form of the report suggests.

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Hunter (2016) developed a discourse-based account of reports with parenthetical readings but non-parenthetical syntax. In particular, Hunter proposed that the discursive contribution of a parenthetical report is to introduce a modal rhetorical relation between the embedded content of the report and the discourse preceding the report. In this paper, we build on the account of coercion developed in Asher (2011) and Asher and Luo (2012) to provide a compositional analysis of Hunter's proposal. We then extend the resulting account to model two facts about parenthetical reports not covered in other models: the fact that factive verbs such as *found out* can also be used parenthetically, as observed in Simons (2007), and the fact that certain discourse connectives seem to block parenthetical readings of reports in their syntactic scope, as discussed in Hunter and Danlos (2014). (4b), for instance, only has a non-parenthetical reading.

(4) a. John didn't come to my party
b. because Jill said he was out of town.

We begin in Section 2 with a presentation of Hunter (2016)'s proposal. We then present the basics of Asher and Luo's account and our application of it in Section 3. Section 4 extends the resulting compositional account to parenthetical readings of factive verbs, and Section 5 examines the effects of explicit discourse connectives on the interpretation of reports.

2. The function of discourse parenthetical reports

Following Hunter (2016), we will call reports with a parenthetical interpretation but non-parenthetical syntax, such as (2b), *discourse parenthetical* to indicate that their parenthetical interpretation follows from discursive facts. There are no morphological features, like the evidential markers found in many languages, that force (2b) to receive an evidential reading. Nor should we assume that (2b) has an underlying parenthetical syntax that differs from its surface form. (See Simons, 2007: for arguments against a syntactic account.) There may be semantic differences between a parenthetical reading of a report and a non-parenthetical reading of the same report in the sense that the two interpretations might support different entailments. Normally, an instance of a speech or attitude report with a non-factive embedding verb such as *say* does not entail any level of commitment to the embedded clause, as illustrated by (1). In the absence of further context, however, the discourse in (2) arguably entails the possibility that John was out of town: if the speaker is not committed to this possibility, the relevance of (2b) to (2a) is unclear. Still, these entailments do not follow from (1b) and (2b) alone; they are *discourse-level* entailments that result from the interaction of a report and another discourse unit in the preceding discourse.

That the interpretation of a discourse parenthetical report results from the way a report is used in a discourse has been observed numerous times in the literature on parenthetical reports in English (Hooper, 1975; Simons, 2007; Urmson, 1952). Formal models of their discursive behavior are harder to come by. What does it mean to say that a parenthetical reading follows from the way that a report is used? How do we define the discourse function of a parenthetical report?

Simons (2007) sketched a diagnostic for parenthetical readings using question/answer pairs like (5).

(5) a. Why wasn't John at the party?
    b. Jill said that he was out of town.

In (5), only the embedded clause of (5b) is 'at-issue', in Simons' sense, because only the embedded clause provides an answer to the question posed in (5a). According to Simons' proposed diagnostic, a parenthetical report is one in which only the embedded clause is at-issue. Thus this diagnostic predicts, seemingly correctly in this case, that (5b) is parenthetical.

This suggestion is not yet an account, however, because it does not provide a general model of discourse function that could be applied in the absence of explicit question/answer pairs. In the case of (2), we can imagine that (2b) answers a question like *Why not?*, but short of a predictive account of how one can identify implicit questions, Simons' question/answer-based diagnostic cannot be used for arbitrary discourses. Moreover, the diagnostic does not yield an analysis of cases in which a speaker explicitly denies the embedded content of a seemingly parenthetical report. Suppose, for example, that the speaker in (2) followed (2b) with (6):

(6) But that's a total lie because I saw him out walking his dog early the next morning.

Given (6), we cannot say that the embedded content of (2b) answers the question *Why not?* or *Why didn't John come to your party?*—the speaker explicitly commits herself to the negation of that content.

A final concern is how to model reports for which both the embedded clause and the report as a whole are relevant to the discourse but in different ways. To put this in terms of Simons' diagnostic, how do we handle cases in which both the embedded clause and the report as a whole answer questions that have been posed in the discourse, as in (7)?

(7) a. Why didn't John come to your party? Did anyone tell you?
    b. Jill said he was out of town.

In such examples, it's hard to say that one part of the report is at-issue while the other isn't; it's rather that the embedded clause and the report as a whole are *at-issue relative to different discourse units*. Of course, in (7), the second question is obviously very relevant to the first, but as emphasized in Hunter (2016), this is not always the case; the two parts of a report can be relevant to separate discourse units whose relevance to one another is much less clear.

Hunter (2016) argues that rhetorical theories (Asher, 1993; Asher and Lascarides, 2003; Hobbs, 1985; Mann and Thompson, 1988) can provide a model for the discourse function of parenthetical reports that generalizes Simons' suggestion and is more suitable for arbitrary discourses.[2]

[2]This suggestion has been made before. See Danlos and Rambow (2011); Dinesh et al. (2005); Hardt (2013); Hunter et al. (2006). Hunter (2016) examines past efforts to model parenthetical reports in rhetorical accounts and details many of the problems faced by these earlier proposals.

In a theory of rhetorical structure, what it means to have a certain discourse role or function is to enter into a particular rhetorical relation (or set of relations). The heart of Hunter (2016)'s proposal is that a report p is parenthetical just in case the embedded clause of p enters into a rhetorical relation R with a discourse unit that is discourse prior to p—that is, prior to the entire main clause of p—and the attributive predicate does not contribute to this relation. In (2), for example, (2a) is discourse prior to (2b), but the attributive predicate of (2b) does not contribute to the explanatory relation that is proposed to hold between the content in its scope and (2a):

(8) Explanation(*John didn't come to my party*, *he was out of town*)

This approach bypasses the need for implicit questions[3], allows that both the embedded clause and the report as a whole can play independent rhetorical roles, and generalizes Simons' diagnostic for parenthetical reports on the assumption that answering a question yields a rhetorical relation between a question and its answer.

An important aspect of Hunter's proposal is that the rhetorical relation that relates the embedded clause of a parenthetical report to the preceding discourse will fall in the scope of a possibility operator. (8) poses a problem as it stands because Explanation is a *veridical* relation (Asher and Lascarides, 2003). This means that an instance of (8) cannot be true in a context unless both of its arguments are true in the same context. This is intuitively correct for (2): for John's being out of town to explain his absence at the party, he must have actually been out of town. The logical form in (8) is therefore too strong; as stressed by Simons (2007), reports are often used in situations like (2) precisely to hedge one's commitment to the embedded content. In some contexts it might be possible to infer full speaker commitment to this content, but a parenthetical use of a report does not in and of itself require such a strong commitment.

To weaken the entailments of a parenthetical report, the first step is to exploit the syntactic and semantic features of the report and assume that the attributive predicate takes not only syntactic scope over the embedded clause, but discourse scope over it as well. That is, the embedded clause is related to the attributive predicate via a rhetorical relation of Attribution, and the embedded clause is subordinate to the attribution predicate in the discourse representation. (9) gives the contribution of the Attribution relation to the logical form of the discourse.

(9) Attribution(*Jill said that*, *he was out of town*)

Semantically, this means that the embedded content of a report will not be entailed, at least not in virtue of figuring in an Attribution relation. (10) describes the entailments of the two arguments of an Attribution relation.

(10) a. *Jill said that*: $\models \exists p.\text{said}(\text{Jill}, p)$
b. *he was out of town*: specifies the content of p, but $\not\models p$

[3] We leave open here the possibility that discourse relations might be modelled in a question-based model, though see Hunter and Abrusán (2016) for a discussion.

Of course, the Attribution relation is a general one that will apply to non-parenthetical reports as well. As such, Attribution will not support the stronger entailments that we see with parenthetical reports. Thus we arrive at the following impasse: if in building the representation for a parenthetical report, we ignore the discursive contribution of the Attribution relation, we will predict overly strong entailments. If we add Attribution to correct this, we end up with overly weak entailments.

To get around this problem, Hunter (2016) proposed a general rule that any time a discourse unit β figuring in an Attribution relation of the form $Attribution(\alpha,\beta)$ is rhetorically related to a unit γ that is textually prior to α, and thus outside of the scope of the Attribution, a relation R that can be inferred to hold between γ and β based on the contents of γ and β alone is weakened to $\Diamond R$. This rule is formalized in PA below, where e and e' are edges in a discourse graph that connect nodes representing discourse units; α, β and γ are labels for discourse units; and l is a labelling function that maps each edge to a label for a discourse relation (e.g., Attribution).

PA: $(\exists e.e(\alpha,\beta) \wedge l(e) = Attribution) \rightarrow (\exists\gamma\exists e'(\gamma <_t \alpha \wedge e'(\gamma,\beta)) \rightarrow \exists R(l(e') = \Diamond R))$

The effects of PA are illustrated in Figure 1.

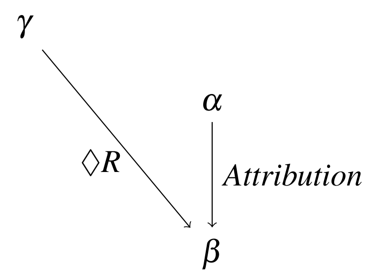

Figure 1: Relations to units inside Attributions

PA is designed to capture the idea that when a speaker uses a report parenthetically, she uses the attributive predicate as a kind of buffer so that the embedded content can be relevant, but she does not have to fully commit to its content. From the perspective of discourse structure, PA reflects the fact that even if an attribution predicate does not seem relevant or ‘at-issue’ with regard to the preceding discourse, it nevertheless plays a crucial function in the overall discourse by affecting the relation inferred between its embedded clause and the preceding discourse.

Some consequences of adopting PA are, first, that it respects the constraint of veridicality imposed by many discourse relations, including Explanation, because a modal discourse relation only entails the possibility that its arguments are true:

(11) $\Diamond R(\alpha,\beta) \models \Diamond(\alpha \wedge \beta)$

A full commitment to the content of β will be consistent with a formula of the form $\Diamond R(\alpha,\beta)$, but it will not be necessary. At the same time, commitment to $\neg\beta$ will be inconsistent with a formula of the form $\Diamond R(\alpha,\beta)$, as desired.

A further desirable consequence is that both α and β can be discourse relevant. Nothing in this proposal hinges on a binary distinction between at-issue and not-at-issue content, which, as argued in Hunter (2016), is untenable when we look at the way reports are actually used in longer stretches of discourse.

Hunter's account, however, leaves some important questions about the nature of PA unanswered. First, what triggers PA and can we derive it compositionally? Also, does $\Diamond R(\alpha,\beta)$ yield the right entailments for α? Are there any examples in which a parenthetical report weakens a speaker's commitment to the argument α? In the next section, we argue that the transformation described by PA is a type of coercion, as understood in the frameworks of Asher (2011) and Asher and Luo (2012), and explain the entailments of a formula of the form $\Diamond R(\alpha,\beta)$ in more detail.

3. Coercion

Coercion is an observed process whereby the meaning of a predicate P combines with the meaning of an expression e in its scope to produce a meaning shift. To illustrate, the predicate *is a very fancy and tasty Bordeaux* in (12) combines with the noun phrase *this bottle*, yet the final interpretation does not involve a predication of the bottle, but of the *contents of* the bottle.

(12) This bottle is a very fancy and tasty Bordeaux.

The combination of *is a very fancy and tasty Bordeaux* with *the bottle* coerces a shift in meaning. Coercion, many have argued, is the result of an adjustment to either the meaning of the predicate, the meaning of the argument, or to the composition that fits their meanings together, so that the argument of the predicate satisfies the predicate's selectional restrictions, which in "ordinary circumstances" the argument does not. In (12) the predicate has to hold of wine or at least something that is edible or potable, and a mechanism of coercion like that proposed in Asher (2011) reinterprets the predication so that the predicted meaning is something like *the content of this bottle is a very fancy and tasty Bordeaux*.

Our claim is that a relation of the form $\Diamond R$ that relates the embedded content of a parenthetical report to the preceding discourse is the product of coercion, triggered by a conflict between the demands of the Attribution relation and the demands of R. To unpack this claim, we begin with a brief overview of some relevant aspects of *Segmented Discourse Representation Theory* (SDRT; Asher and Lascarides, 2003), the formal framework that we will use to develop our coercion account.

The language of SDRT contains a countable set of discourse unit labels $\mathsf{DU} = \{\pi,\pi_1,\pi_2,\ldots\}$, and a finite set of discourse relation symbols $\mathbb{R} = \{R,R_1,\ldots R_n\}$, and formulas $\phi,\phi_1,...$ from some fixed language L for describing elementary discourse move contents, where L is a language like that of higher order logic used in, for instance, Montague Grammar. SDRT formulas are of the form $\langle\pi\colon\phi\rangle$, where ϕ is either: (i) a formula of L; (ii) a relational formula of the form $R(\pi_1,\pi_2)$, which says that π_1 stands in relation R, e.g., Explanation or Attribution, to π_2;

(iii) a formula of the form $\Diamond\psi$ where ψ is an SDRT formula; or (iv) a conjunction of SDRT formulas. To provide an illustration, (2) yields three discourse units, π_1, π_2, and π_3:

π_1 : John didn't come to my party.

π_2 : Jill said that

π_3 : he was out of town.

Each of these units is then associated with a formula of L—ϕ_1, ϕ_2 and ϕ_3, respectively—that specifies its content. For ϕ_2, for example, the formula is $\exists p$.said(Jill,p); for ϕ_3, the formula is, Out-of-town(Sel(John, Jill, party), where Sel, a part of the vocabulary of L, is a function picking out an appropriate individual type variable or discourse referent from the logical forms for the discourse so far (the formulas for π_1 and π_2). The combination of $\pi_1 - \pi_3$ in (2) will also yield two further formulas, Attribution(π_2, π_3) and $\Diamond$ Explanation(π_1, π_3).

How do we derive these formulas? While the Attribution relation between π_2 and π_3 is syntactically determined and triggered by the embedding verb *say*, the derivation of $\Diamond$ Explanation(π_1, π_3) involves a more complicated process. SDRT requires that any discourse unit π' must, if it is not discourse initial, be rhetorically connected to some other unit π, if it is to make a coherent contribution to the discourse in which it figures; every coherent discourse can be represented as a directed, acyclic and weakly connected graph. This means that at least one part of the report in (2b) must be related to the preceding discourse. In this case, the preceding discourse consists of a single unit, so the task is simplified: either π_2 or π_3 must be related to π_1.[4]

Often, the relation to the preceding discourse is not specified via a syntactic connection or an explicit discourse connective such as *because*. Where the selection of a relation or a discourse constituent is left unspecified, SDRT exploits the *Sel* function; $\mathrm{sel}_{\mathbb{R}}(\mathrm{sel}_{\Pi}\{\pi_m, ...\}, \mathrm{sel}_{\Pi}\{\pi_n, ...\})$, for instance, says that some relation from the set $\mathbb{R}$ of relations must be selected to apply to a selection of constituents from $\{\pi_m, ...\}$ and from $\{\pi_n, ...\}$. In (2), the connection between (2b) and (2a) is not explicitly marked, so the axioms of SDRT only yield a very underspecified contribution:

(13) $\mathrm{sel}_{\mathbb{R}}(\pi_1, \mathrm{sel}_{\Pi}\{\pi_2, \pi_3\})$.

In words this means that some discourse relation selected from the set $\mathbb{R}$ of discourse relations must hold between the constituent π_1 and one of the constituents introduced in (2b). Which discourse relation and which constituent are ultimately chosen to flesh out an underspecified formula depends on semantic and syntactic constraints and the surrounding discourse context. Combining the discourse units $\pi_1 - \pi_3$ from (2), their associated contents, (13), and Attribution(π_2,π_3), we arrive at the logical form in (14). (14) is given in the SDRT language using a richly typed, dynamic, compositional framework (Asher and Pogodalla, 2011).

(14) $\exists \pi_1, \pi_2, \pi_3(\pi_1 : \neg\text{come(john, my-party)} \wedge \pi_2\text{: say(jill}, \pi_3) \wedge \pi_3\text{: out-of-town(john)}$
$\wedge\ \lambda x \lambda y\ \mathrm{sel}_{\mathbb{R}}(y,x)(\pi_1)(\mathrm{sel}_{\Pi}\{\pi_2, \pi_3\}) \wedge \text{Attribution}(\pi_2,\pi_3))$

[4]Were (2) embedded in a larger discourse, both π_2 and π_3 might be related to the preceding discourse. In fact, adding discourse connections can increase the unity and coherence of a discourse. This is captured in the principle Maximise Discourse Coherence from Asher and Lascarides (2003).

Let's now look at how we would resolve the underspecification in (14) in the context of a coercion story. The contents of π_1 and π_3 support Explanation(π_1, π_3), and in fact, this is the most probable connection to π_1 in this case. Normally we would infer this relation to resolve the choice of rhetorical relation in (13), but because of the Attribution relation between π_2 and π_3, we run into a conflict.

To make this conflict precise, we begin by assigning types to the variables $\pi_1, \pi_2, \ldots$ that represent discourse units in SDRT. There are two types for discourse representation variables, UP (U), for *uncommitted*, and DOWN (D), for *determinate*. The general idea is that the content associated with a variable of type D will be entailed by the discourse; for a variable of type U, neither its associated content nor the negation of this content will be entailed. Veridical relations, including Explanation, Elaboration, Narration, Contrast, and so on, are of type $\mathrm{D} \rightarrow \mathrm{D} \rightarrow \mathrm{D}$. Non-veridical relations, including Conditional and Disjunction, have the type $\mathrm{U} \rightarrow \mathrm{U} \rightarrow \mathrm{D}$. Attribution is a *right*-nonveridical relation, meaning that it is non-veridical in its right argument; that is, it has the type $\mathrm{D} \rightarrow \mathrm{U} \rightarrow \mathrm{D}$.

The proposed typing for Attribution is designed to reflect the fact that the act of attributing content to an agent should not in itself require speaker commitment to the attributed content. As it stands, however, it does not capture the fact that the content inside of an Attribution's scope might itself contain relations that are veridical. For instance, consider:

(15) [Jill said that]$_{\pi_1}$ [John went running at 6]$_{\pi_2}$ [and he went to dinner with Julie at 7.]$_{\pi_3}$

where π_1, π_2, and π_3 label the elementary discourse units.[5] The SDRS K for (15) contains a complex discourse unit, π_0, that itself contains a discourse relation. (16) gives its logical form.

(16) $\exists \pi_0, \pi_1, \pi_2, \pi_3(\text{Attribution}(\pi_1, \pi_0) \wedge \pi_0 : \text{Narration}(\pi_2, \pi_3))$

The formula Attribution(π_1, π_0) requires π_0 to be of type U, but this conflicts with the type D assigned to the veridical relation Narration(π_2, π_3). A similar problem arises with conditionals:

(17) [If John doesn't have to work this evening]$_{\pi_1}$ [then he will go running]$_{\pi_2}$ [or he'll go play squash.]$_{\pi_3}$

We get the following logical form:

(18) $\exists \pi_0, \pi_1, \pi_2, \pi_3(\text{Conditional}(\pi_1, \pi_0) \wedge \pi_0 : \text{Disjunction}(\pi_2, \pi_3))$

The relation Conditional requires π_0 to be of type U; Disjunction requires it to be of type D.

In the case of both Conditional and Attribution, we need to capture the fact that veridical relations in their scope are only veridical *relative to a context* introduced by the antecedent of the conditional or the attribution predicate, respectively. To do this, we relativize types to con-

[5]We use square brackets to mark the boundaries of discourse units.

texts.[6] A context will be represented as a *segmented discourse representation structure* (SDRS) or formula under the scope of an operator; the outermost SDRS K_0 is a context, as is any SDRS K_i that is a constituent of K_0 and is within the scope of an operator. Note that a formula under the scope of a modal operator also serves as a typing context. If a discourse unit is typed D in a context K, which we will write as π^K: D, then its normal entailments are entailed in K; more precisely, if π^K: D, the content associated with π must be satisfied at worlds or points of evaluation in which any relations in K involving π are satisfied. If a discourse unit π is such that π^K: U, then the content of π is not entailed in K even if it figures in a relation R that is entailed in K. By relativizing types to contexts, we capture the idea that while a speaker may not be committed to the content of a report, when she attributes content to another agent, she commits *to the other agent being committed* to the report's content. Note that in an SDRS, an instance of a discourse relation R occurs in one and only one context.

The relation between the entailments of a context K and the entailments of a context K′ embedded in K obeys the following retyping rule: where K is a context, $\pi^K : u$, and where K′ is a constituent of K under the scope of a modal operator or intensional relation, then $\pi^{K'} : d$ is an allowable typing. We also allow type raising from D to U when we shift from a context K′ to a context K in which K′ is embedded: if $\lambda\pi\psi$ requires a discourse unit of type U as argument in K, but is given an argument π_1 of type D from K′, then a general coercion permits us to rewrite the type of π_1 to U; i.e. π_1^K: U. Finally, for any constituent π in K introduced by an indicative clause not in the scope of an intensional operator or intensional relation in K, π^K: D.

We say that an SDRS K has a *consistent type assignment* just in case: K respects the retyping rule; the discourse relations in K have arguments of the type required by the semantics of the relations; and for every context K′, and for every discourse unit π in K′, π has a unique type assignment relative to K′. The SDRS K for (16), for instance, has a consistent type assignment in which π_1: D and, after type raising, π_0: U in K. But π_0 is an SDRS in the scope of an intensional relation; it therefore constitutes a typing context of its own and specifies its own assignments to discourse units figuring in discourse relations in π_0. In this context, π_0 is of type D—i.e., $\pi_0^{\pi_0}$: D; and we also have $\pi_1^{\pi_0}$: D and $\pi_2^{\pi_0}$: D, which yields a consistent typing of K.

We note that examples like (19) do not require any kind of retyping or context shifting. While (19b) and the embedded clause of (19a) have the same propositional content, they contribute different discourse units and can therefore receive different type assignments.

(19) a. Jill said John was out of town.
b. And (indeed) he was out of town.

The types we have assigned to discourse units are distinct from the types assigned to contents, just as the contents associated with discourse units are distinct from the units themselves. The fact that (19b) serves as a correction or amplification of (19a) is because the same content is now linked to a label that commits the speaker to John's being out of town.

[6] For more on typing within contexts, see the notion of *coercive sub-typing*, e.g. Luo (1999).

The conflict that induces the coercion observed with the parenthetical report in (2b) is triggered by the fact that the Attribution relation and the Explanation relation in (2) share the same second argument, namely π_3, but Explanation types this argument as D, while Attribution types it as U. More generally, discourse parenthetical reports will always trigger this kind of conflict; as explained in Hunter (2016), we do not find the embedded clauses of discourse parenthetical reports in non-veridical relations such as Disjunction or Conditional. The only available reading of (20), for example, is one in which *Linda said* takes scope over the entire conditional.

(20) If John finishes his housework, then Linda said he'll come to the party.

In this case, the report is not parenthetical.

To resolve the conflicting type requirements imposed by a formula of the form Attribution(π, π') on the one hand and a veridical relation that takes π' as an argument on the other, something has to give: either the type assignment for a constituent, the type of the predicates over the constituents (i.e. the discourse relations), or the way these predicates combine with their arguments has to change. Our retyping rule will not solve the conflict: suppose we replace $\lambda x \lambda y \text{sel}_R(y,x)(\pi_1)(\text{sel}_\Pi\{\pi_2,\pi_3\})$ in (14) with Explanation(π_1, π_3), which requires π_3 to have the type D. Raising π_3 from D to U will leave Explanation with an argument of type U, which conflicts with its veridical semantics. The retyping rule would only work if the entire Explanation were under the scope of the Attribution.

Retyping π_3 from U to D in Attribution(π_2, π_3) will not work either. An important principle of the account of coercion in Asher (2011) is that lexical items or grammatically determined types do not change their type due to coercion, and Asher (2011) adduces considerable evidence for this principle. We believe that this principle is also plausible at the discourse level. Given this assumption and the fact that the Attribution relation is grammatically determined, we cannot change the type requirements of Attribution. It follows that π_3 will retain its typing of U in the context of the Attribution, and there is therefore no consistent type assignment for an SDRS that includes those two relations on π_3.

Shifting the type of π_1 or π_2 would also be ineffective, because doing so would only introduce a conflict between these discourse referents and the requirements of Explanation and Attribution, respectively. Shifting the inferred link between π_2 and π_3 is not allowed because the link is grammatically determined. The only possibility, then, is to shift the inferred link between π_3 and π_1. To spell this out formally, we need two things. We need to specify how the predication within a given context changes using a functor that takes a relation R and its two arguments α and β and returns a modified predication of R applied to α and β; this is easy to do with our types and the availability of a modal operator. The other task is to specify what predicate licenses the introduction of the functor.

We begin with the second task. In standard coercion cases, the licensing predicate is typically R itself. For discourse coercions, however, it is the discourse environment that typically licenses the coercion. In particular, it is the presence of the Attribution that licenses the coercion of the environment involving the Explanation relation. Given the contents of π_1, π_2

and π_3, the discourse model selects the most plausible specification for $\mathrm{sel}_{\mathbb{R}}$ and sel_{Π} in (14): Explanation(π_1,π_3). From the discourse model, we then rewrite the logical form in (14) as:

(21) $\exists\pi_1,\pi_2(\pi: \neg\text{come}(\text{john},\text{my-party}) \wedge \pi_2\text{: } \exists\pi_3\text{say}(\text{jill},\pi_3) \wedge \pi_3\text{: out-of-town(john)}$
$\wedge\ \lambda x\lambda y\ \text{Explanation}(y,x)(\pi_1)(\pi_3) \wedge \text{Attribution}(\pi_2,\pi_3))$

But now we have a type conflict on π_3, and λ reduction cannot proceed further: the type that Explanation requires of π_3 (D) conflicts with the type assigned to it by Attribution (U) in $\mathrm{K}_{(21)}$.

This type clash leads to the introduction of a coercion functor that can be specified as follows.

- Coercion to $\Diamond$R: $\mathfrak{f}$: $\lambda\beta$: U. $\lambda\alpha$: D. λR: D $\rightarrow$ D $\rightarrow$ D. $\Diamond R(\alpha,\beta)$.

The presence of the Attribution entailing the typing π_3 : U together with the simple assertion of (2a) entailing π_1 : D and the discourse model's prediction of a veridical relation's holding of π_1 and π_3 license a rewriting of

(22) $\lambda x\lambda y\ \text{Explanation}(y,x)(\pi_1)(\pi_3)$

as

(23) $\mathfrak{f}(\lambda x\lambda y\ \text{Explanation}(y,x))(\pi_1)(\pi_3)$

λ-reduction can proceed now that the types all match, yielding:

(24) $\Diamond\ \text{Explanation}(\pi_1,\pi_3)$

So our final logical form for (2) looks like this:

(25) $\exists\pi_1,\pi_2(\pi_1: \neg\text{come}(\text{john},\text{my-party}) \wedge \pi_2\text{: } \exists\pi_3\text{say}(\text{jill},\pi_3) \wedge \pi_3\text{: out-of-town(john)}$
$\wedge \Diamond\ \text{Explanation}(\pi_1,\pi_3) \wedge \text{Attribution}(\pi_2,\pi_3))$

Note that $\mathfrak{f}$ is a conservative functor that maintains consistency with the original requirement of a veridical relation R such that $R \models \Diamond R$. Note also, however, that $\Diamond$ itself specifies a typing context, so that within the context of $\Diamond$ it is consistent to have π_1 : D and π_3 : D, as would be needed if a veridical relation had fallen in the scope of *Jill said* in (2b) (cf. (15)).

The functor $\mathfrak{f}$ does not change the type of either α or β; it rather shifts the relation inferred between them to a relation that is compatible with arguments of either type D or type U. Because the type of the arguments stays constant, the entailment in (11), repeated here as (26), does not reflect the actual entailments of an example like (2).

(26) $\Diamond R(\alpha,\beta) \models \Diamond(\alpha \wedge \beta)$

In (2), the content of (2a) is asserted independently of the subsequent discourse, and is therefore of type D; the functor simply renders the relation compatible with the typing of π_3, which is U. We can therefore make the stronger claim for an example like (2):

(27) $\Diamond R(\alpha,\beta) \models \alpha \wedge \Diamond\beta$

This conforms to the intuition that (2a) is entailed in (2).

This entailment requires some unpacking. The formula (25) entails, as described in (27), that the content of π_1 is satisfied at the actual world and the content of π_3 is satisfied at a world consistent with the speaker's commitments. Yet to the extent that a causal relation might hold between the eventualities e_α and e_β described by α and β, respectively, the Explanation relation as well as e_α and e_β must all hold in the same world. This is ensured by a fact about epistemic possibilities: given that π_1 is asserted, the speaker is committed to it, and so the content of π_1 holds at *all* worlds consistent with her commitments. What $\Diamond$Explanation(π_1,π_3) adds is the claim that in some of those commitment worlds, π_3 is also verified, and furthermore, in at least some of those worlds, π_3 describes an eventuality that caused that described by π_1. In other words, under the scope of $\Diamond$, π_1 and π_3 are of both type D, so the constraints on Explanation are satisfied.

Interestingly, there is an asymmetry in coercion facts. While (2) seems to have a discourse parenthetical reading of the sort we have derived in (25), an example that inverts the form of (2) does not.

(28) a. Jill said John is sick.
b. He ate a bad clam.

The claim in (28b) is naturally interpreted either as extending the report context introduced by (28a)—thus committing Jill to the content of (28b)—or as providing an explanation not only of why John is sick but also, in effect, of why Jill said what she did.

As defined, the functor $\mathfrak{f}$ only works if the *second* argument of the coerced relation is U. In (28) it is the first argument of the implicit causal relation that is typed U, so our functor $\mathfrak{f}$ will not apply to this case. Our account thus predicts that we can never have an instance of a veridical relation whose left argument is the embedded clause of a report and whose right argument is outside of the scope of the report (i.e. we can never coerce the argument of an Attribution to D).

This is surprising and may even seem suspicious. Yet some data, including (28), suggest that we should not countenance a functor $\mathfrak{g}$: $\lambda\beta$: D. $\lambda\alpha$: U. λR: D$\rightarrow$D$\rightarrow$D. $\Diamond R(\alpha,\beta)$. One reason for not stipulating the functor $\mathfrak{g}$ is that alternative means of producing a modalized relation exist:

(29) a. Jill said John is sick.
b. Maybe it's because he ate a bad clam.

Simple assertions allow for modalisation in a way that reports do not. There is no way to lexically induce the possible explanation reading for (2)—a speaker must either choose a report construction, which carries the extra information of a source, or a simple modal. Combining the two leads to non-parenthetical readings of the reports. So the presence of such alternatives for the inverted ordering might explain the asymmetry between our intuitions about (2) and (28).

On the other hand, there are examples, like (30), in which something like coercion of the first argument seems to work.

(30) [The school said]$_\pi$ [Isabel is sick.]$_{\pi_1}$ Maybe [she caught Rose's flu.]$_{\pi_2}$

This example implies $\Diamond$Explanation(π_1, π_2). However, note that (30) differs from (2) in that π_2 falls within the scope of a modal. We think that (30) manifests a kind of modal subordination involving the intensional context provided by Attribution(π, π_1) and the modal operator contributed by *Maybe*. Modal subordination could allow for an attachment between the two discourse units of type U, yielding a formula of the form:

(31) $\exists \pi, \pi_1, \pi_2(\text{Attribution}(\pi, \pi_1) \wedge \pi: \text{school said} \wedge\ \pi_1: \text{sick(isabel)}$
$\wedge \Diamond(\text{Explanation}(\pi_1, \pi_2) \wedge \pi_2: \text{caught(isabel,flu)}))$

Given that $\Diamond$ is a normal modality, (31) implies $\Diamond$Explanation(π_1, π_2).

(32) provides another case in which a $\Diamond R$ is arguably inferred from a first argument of type U and a second argument of type D:

(32) [Where was John on Tuesday evening?]$_\pi$ [Jill said that]$_{\pi_1}$ [she and John went running at 6.]$_{\pi_2}$ [Then/After that, he and I had dinner at 7.]$_{\pi_3}$

(32) intuitively implies $\Diamond$Narration(π_2, π_3). In this case, however, it is the surrounding discourse structure that indirectly sets up the coercion on Narration. The answer to the question in π includes π_2 and π_3. But let's concentrate first just on relating π, π_1 and π_2. The connections between these units will parallel those between the units in (2), yielding $\Diamond$QAP(π, π_2), where *QAP* stands for *Question-Answer-Pair*. Now π_3 simply extends the answer that is being proposed by π_2 to a more complicated answer: perhaps the proposed sequence of events answers the question posed in π. Semantically, this means that in some world w from the set of worlds compatible with the speaker's commitments, π_2 and π_3 hold in w and the eventuality described by π_3 took place after the eventuality described by π_2 in w. In other words, there is an attachment of π_3 to π_2 forming a Narration under the scope of the modal introduced by the QAP, in a manner similar to the logical form for (16). This gives the following, abbreviated logical form:

(33) $\exists \pi, \pi_1, \pi_2, \pi_3, \pi_4.(\text{Attribution}(\pi_1, \pi_2) \wedge \Diamond\text{QAP}(\pi, \pi_4) \wedge \pi: \text{Where was John?}$
$\wedge\ \pi_1: \text{Jill said} \wedge \pi_2: \text{running} \wedge \pi_3: \text{dinner} \wedge \pi_4: \text{Narration}(\pi_2, \pi_3))$.

We note several consequences of (33). First, the Narration relation and its temporal consequences hold only between the events described in π_2 and π_3, not the time of Jill's saying, as intuitions dictate. Second, because of (27), $\Diamond$QAP(π, π_4) entails $\Diamond$Narration(π_2, π_3), as desired, even though this formula is not in the logical form. Third, this is the only possible SDRS given our constraints on consistent typing. We could not put Narration(π_2, π_3) outside the scope of the $\Diamond$QAP relation in (33), because $\pi_2^{(33)} : \textsc{u}$ and this would conflict with typing demands of Narration as a veridical relation.

Example (32) does not provide a genuine motivation for adopting the functor $\mathfrak{g}$ described above. $\Diamond$Narration is indeed entailed, but not because of a direct conflict between Narration and Attribution; it's epistemic status follows from the fact that π_3 develops a context that is already modal. At the same time, given that the speaker asserts π_3, its contents will hold at all worlds consistent with her commitments, including the actual world whether or not it is also a π_2 world. Thus we arrive at the following consistent top-level typing for (33): $\pi^{(33)} : \textsc{d}$, $\pi_1^{(33)} : \textsc{d}$, $\pi_2^{(33)} : \textsc{u}$, and $\pi_3^{(33)} : \textsc{d}$. Indeed, our typing rules mandate these. Our typing rules also permit $\pi_2^{\pi_4} : \textsc{d}$, $\pi_2^{\pi_4} : \textsc{d}$, and $\pi_4^{\pi_4} : \textsc{d}$ as part of a consistent typing.

Our account right now relies on the potentially controversial assumption that Attribution always types its second argument as U. We now turn to a discussion of this assumption in the context of factive embedding verbs.

4. Factives

On our proposal, the type assigned to a rhetorical relation R is entailed by R's semantics; it is a property of the relation itself. As a result, the type is unaffected by semantic differences between connectives that license R. This means that Attribution, for example, will have the type $\textsc{d} \rightarrow \textsc{u} \rightarrow \textsc{d}$ even when triggered by a factive verb, as in (34).

(34) a. John didn't come to my party.
b. Jill found out that he's been working nights at the station.

This might at first seem counterintuitive. After all, a factive verb entails the truth of its complement, so shouldn't its complement have the type D?

First of all, it is important to distinguish between the discourse contribution of a report and its interpretation. The discourse contribution determines what relation is added to the logical form for a discourse, but while these relations play a significant role in discourse interpretation, they do not tell the whole story. The content of discourse units certainly effects interpretation, and in the case of reports, world knowledge or opinions about the reliability of sources cited in reports (de Marneffe et al., 2012) can influence what information interpreters ultimately take away. There is therefore no problem with saying that discourse structure contributes certain entailments and that the content of discourse units, including the semantics of the various embedding verbs used in reports, can strengthen these entailments. A typing of U for a clause embedded under a factive verb is consistent with the demands of the verb, but the final discourse level entailments triggered by reports with factive verbs can ultimately be stronger. What we have modeled is the general function of discourse parenthetical reports, and we are take as basic that the attribution predicate of such a report acts as a buffer between the embedded content and the preceding discourse.

What's more, in many cases, the claim that discourse parenthetical reports involving factive embedding verbs trigger relations of the form $\Diamond R$ is more than consistent with the demands of factive verbs—it is also borne out by the data. Even Attributions triggered by factive verbs allow a speaker to hedge her commitment to the discourse function of the embedded clause. If a speaker A asks, (a) "Why didn't John come to the party?", a speaker B can reply, (b) "Jill found out that he has taken on a night job" and thereby hedge her commitment to the Question/Answer relation suggested by the contents of (a) and (b), even while committing to the truth of the embedded clause in (b) in virtue of the factivity of *find out*. Factivity licenses an inference *from* the discourse logical form but does not contribute type information to its *construction*, and thus doesn't affect the typing relevant to the interaction between attributions and the surrounding discourse context. This formalizes the observation in Simons (2007) that parentheticality and factivity are orthogonal notions.

Of course, intonation plays a role in the way that discourse parenthetical reports are ultimately interpreted. A more certain and declarative intonation for (b) above might encourage the interpretation of an Explanation rather than the weaker $\Diamond$Explanation relation. Intonation certainly plays an important, if poorly understood, role in discourse interpretation. Nevertheless, even a declarative intonation does not *force* the stronger interpretation. Speaker B could continue (b) with (c): "That might be why he didn't come," thereby making the $\Diamond$Explanation explicit. Our point is that the use of a factive verb in a discourse parenthetical report does not in and of itself require a non-modal relation; the systematic discourse contribution of *all* reports is the weaker $\Diamond R$. Strengthening of this relation at the level of discourse interpretation must be explained by independent factors.

5. Connectives

As we've seen, while the content of (2a) and the embedded content of (2b) together lead the discourse model to predict an Explanation relation, other information from (2) triggers a coercion. This coercion is blocked once we make the causal connection explicit as noted by Hunter and Danlos (2014). The report in (35b) can only receive a non-parenthetical reading.

(35) a. John didn't come to my party
b. because Jill said he was out of town.

A consequence of our coercion story is that the typing demands of a connective with a grammatically determined scope must be satisfied. We predict this because the semantics of the connector *because* entails a non-modal commitment to Explanation over its complement clause, and our coercion account cannot change such grammatically given entailments.

The contrast between (36) and (37) also illustrates this point, though the data are more subtle.

(36) a. Liz's album got a bad review.
b. John said she's really upset.

(37) a. Liz's album got a bad review,
b. so John said she's really upset.

In (36b), John's saying what he did might be completely independent of the review mentioned in (36a); (36b) arguably has a parenthetical reading and licenses $\Diamond$Result. In (37b), to the extent that (37) is acceptable, we infer that John himself suspects that the review caused Liz's distress. The fact that John said what he did is thus a reaction to the review, so the matrix clause of (37b) describes a result of (37a). The matrix clause is of type D, so it satisfies the type demands of Result. At the same time, connecting (37b) to (37a) with Result is only really coherent if the embedded clause of (37b) is also related to (37a) with $\Diamond$Result. But our coercion story still appplies to any connection between the embedded clause of the report with (37a). So in fact we predict a graph with both Result and $\Diamond$Result for (37).

Our prediction does not apply to all explicit connectives. Compare (38) with (35) or (39):

(38) [A man died]$_{\pi_1}$ [after police say/said]$_{\pi_2}$ [he was hit by a fire truck.]$_{\pi_3}$

(39) A man died because police said he was hit by a fire truck

While no inferred $\Diamond$Explanation to the embedded discourse unit is possible in (35) or (39), an inference to $\Diamond$Explanation is involved in the interpretation of (38) (Hunter and Danlos, 2014). This has to do with the semantics and discourse function of *after*, whose semantic scope is not determined by its syntactic position—in (38) the second argument of *after* is π_3. While it marks a temporal relation or possible temporal relation in this case, a causal relation between π_1 and π_3 is also inferred, and there our coercion account applies.

Finally, we note a possible difference between syntactically embedded markers like *because*, connectives like *after* and markers that are marked with a comma, such as *after that* and *afterwards* (cf. Danlos, 2013). Consider the following data from (Hunter & Danlos 2014):

(40) John is very generous. For example, Jill said that he gave $50 to a homeless man yesterday.

(41) John didn't come to the party. Instead, Jill said that he went to dinner with his brother.

Parenthetical readings for (40) and (41) are possible with explicit connectives, but once we embed the connective inside the report, we lose the parenthetical reading of (41):

(42) John didn't come to the party. Jill said instead that he went to dinner with his brother.

All of this suggests that while the typing demands imposed by discourse connectives must in general be respected, further work is needed to understand differences between the various types of discourse connectives.

6. Conclusion

Our main goal in this paper has been to develop a compositional account of the discourse function of parenthetical reports. Hunter (2016) argued that the role of discourse parenthetical reports is to contribute a modal discourse relation to a discourse structure. The derivation of such relations was, however, left unexplained and the $\Diamond$ relations that Hunter posited seemed more like primitive discourse relations. Such an approach does not take into account the fact that discourse parenthetical reports in fact arise from the interaction of an Attribution environment and the surrounding discourse context; the embedded content of a discourse parenthetical report and the discourse unit to which it attaches in the preceding discourse do not on their own support a relation of the form $\Diamond R$. In the account developed here, $\Diamond R$ is derived from R via coercion and a context sensitive notion of typing (Asher and Luo, 2012). The Attribution relation plays a key role in this story by introducing a typing on its second argument that is incompatible with the requirements of the relation R.

We have also extended our basic account to discourse parenthetical readings of factive verbs. In our account, all reports with non-parenthetical syntax are modelled with the discourse relation Attribution, and Attribution always has the type $\mathrm{D} \rightarrow \mathrm{U} \rightarrow \mathrm{D}$, regardless of the embedding verb involved. We argued not only that this is consistent with the demands of factives and a reasonable understanding of how discourse structure contributes to discourse interpretation, but also that discourse parenthetical readings of even factive verbs can entail merely modal relations. As pointed out in Simons (2007), factivity and parentheticality are orthogonal notions.

Finally, we have shown how our account predicts that the attribution clause of a report in the scope of an explicit discourse connective must be relevant to that connective. Pure discourse parenthetical readings in which the attribution predicate is not related to the preceding discourse, or at least not related to the unit to which the embedded clause is related, are predicted to be blocked by explicit connectives because our coercion operation cannot shift grammatically determined types. We did note, however, that some connectives seem to allow parenthetical readings. A detailed case study of different connectives is needed to complete our account, but we think this account is promising enough to warrant such a study in the future.

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Constraints on the embeddability of epistemic modals[1]

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Abstract. In this paper I investigate occurrences of epistemic modals such as *must* and *might* embedded under three classes of attitude verbs: (i) doxastic and doxastic-like verbs like *believe*, (ii) desiderative verbs like *want*, and (iii) emotive doxastic and dubitative verbs like *fear*, *hope* and *doubt*. The first class allows both necessity and possibility epistemic modals; the second class allows neither necessity nor possibility epistemic modals; and finally, the third class allows possibility but not necessity epistemic modals. We begin our inquiry by reviewing Anand and Hacquard (2013)'s proposal. I present some challenges for the proposal and, in particular, for their proposal for class (iii). I show that the restrictions on embedded epistemic modals are similar to the restrictions on embedded V-to-C in German (Truckenbrodt (2006)) and argue that the two phenomena can be given similar explanations.

Keywords: epistemic modals, attitude verbs, embedded V-to-C.

1. Introduction

Epistemic modals can be sometimes embedded under propositional attitude verbs. This paper is a study of what constrains their distribution under attitude verbs, starting from the broad observation that there seem to exist three types of attitudes: those that license epistemic modals in their scope, those that do not allow epistemic modals in their scope, and those that allow possibility but disallow necessity modals. Building on Bolinger (1968)'s generalization, and bulding on a corpus study done by Hacquard and Wellwood (2012), Anand and Hacquard (2013) observe that epistemic modals are acceptable in the complement of doxastic verbs such as *think*, argumentative verbs such as *say*, and semi-factive verbs like *realize*.

(1) a. John thinks that Mary must/might be innocent.
b. John said that Mary must/might be innocent.
c. John realized that Mary must/might be innocent.

The second type includes verbs that do not allow epistemic modals in their complement. These include desiderative verbs such as *want* and directives like *demand*.

(2) a. #John wants Mary to have to be the murderer.
b. #John demanded that Mary must/might have been the murderer.

The third kind includes emotive doxastic attitudes such as *fear* and dubitative verbs such as *doubt*: these verbs only allow possibility epistemic modals in their complement.

[1] I would like to thank the audiences at Sinn und Bedeutung 21, the Linguistics and Philosophy Workshop at the University of Chicago, the SemPrag reading group at the University of Toronto, as well as the linguists and philosophers at the University of Milano-Bicocca.

(3) a. John fears that Mary may/might have known the killer.
b. #John fears that Mary must have known the killer.

(4) a. John doubts that Mary may/might have known the killer.
b. #John doubts that Mary must have known the killer.

2. Anand and Hacquard (2013)

To account for the contrast between the attitude verbs that allow embedded epistemic modals and those that do not, Anand and Hacquard propose that (i) only "representational" attitudes can provide an information state and (ii) embedded epistemic modals quantify over an information state determined by the embedding attitude. Let's begin with point (i). The non-representational nature of a desiderative verb like *want* derives – they claim – from the fact that *want*, unlike *believe*, has a comparative semantics. Following Stalnaker (1984), Asher (1987), Heim (1992), and more explicitly Villalta's work on desiderative predicates (Villalta (2008)), they provide the semantics in (5).

(5) $[\![\textbf{want}]\!]^{c,w,g} = \lambda p.\lambda x.\forall q \in g(C)\backslash p : p >_{DES_{x,w}} q$
where $DES_{x,w}$ is defined as follows:
-for any w, w', w'': $w' >_{DES_{x,w}} w''$ iff w' is more desirable to x in w than w''.
-for any $p, q \subseteq W : p >_{DES_{x,w}} q$ iff $\forall w'' \in q : [\exists w' \in p : [w' >_{DES_{x,w}} w'']]$ and $\exists w' \in p : [\forall w'' \in q : [w'' \not> _{DES_{x,w}} w'']]$

Since *want* – they claim – is non-representational, it fails to provide an information state that will function as the "antecedent" for the embedded modal. As shown in (6), on the other hand, the attitude *believe* does provide an information state, i.e. the subject's doxastically accessible worlds, which will then be the set of worlds quantified over by the embedded epistemic modal.

(6) $[\![\textbf{believe}]\!]^{w} = \lambda p.\lambda x.\forall w' \in Acc_{dox}(w,x) : p(w') = 1$

Part (ii) of Anand and Hacquard's story, i.e. that embedded epistemic modals quantify over an information state determined by the embedding attitude, builds on Yalcin (2010), whose goal was to account for the contrast between (7a) and (7b).

(7) a. Imagine that [it's raining but you don't believe it is].
b. #Imagine that [it's raining but it might not be].

Yalcin's proposal is that the unacceptability of (7b) is due to the fact that the embedded epistemic modal "inherits" its modal base from the quantificational domain of the embedding attitude, generating a contradiction: (7b) asserts that all worlds compatible with the addressee's imagination are worlds where it is raining and there is a world compatible with the addressee's imagination where it is not raining. Extending this idea, Anand and Hacquard propose the general rule in (8).

(8) For any attitude *att*,
$[\![\textbf{att}\ \phi]\!]^{c,w,S,g} = \lambda x.\forall w' \in S'\ [\![\phi]\!]^{c,w',S',g} = 1$, where S' is the quantificational domain provided by **att**.

In the majority of cases this creates structures with redundant meanings, equivalent to a modal sentence with the force of the embedded epistemic modal and the flavor of the embedding attitude.

(9) a. John believes that Mary must be the killer $\equiv$ for all worlds w compatible with John's doxastic state in the evaluation world, Mary is the killer in w.
b. $\forall w \in DOX_J[\forall w'' \in DOX_J$: Mary is the killer in $w'']$ $\equiv \forall w'' \in DOX_J$: Mary is the killer in w''

(10) a. John believes that Mary might be the killer $\equiv$ there is at least a world w compatible with John's doxastic state in the evaluation world such that Mary is the killer in w'.
b. $\forall w \in DOX_J[\exists w'' \in DOX_J$: Mary is the killer in $w'']$ $\equiv \exists w'' \in DOX_J$: Mary is the killer in w''

The third type of attitude verbs we will discuss are emotive doxastic verbs like *fear* and *hope* and dubitative *doubt*. Let's begin with the former. Anand and Hacquard propose the semantics in (11): *a hopes that* ϕ presupposes that *a*'s doxastic state is compatible with both ϕ and $\neg\phi$ and it asserts that ϕ is compatible with *a*'s doxastic state and that ϕ is preferable to $\neg\phi$.

(11) $[\![\textbf{a hope that}\ \phi]\!]^{c,w,S,g}$
a. defined iff $\phi-$verifiers in $S' \neq \emptyset \wedge \phi-$falsifiers in $S' \neq \emptyset$;
(uncertainty condition)
if defined, =1 iff
b. $\exists w' \in S' : [\![\phi]\!]^{c,w,S',g} = 1 \wedge$
(doxastic assertion)
c. $\wedge\phi-$verifiers $>_{DES_{a,w}} \phi-$falsifiers
(preference assertion)

When the complement is modalized, then we have (12).

(12) $[\![\textbf{a hope that}\ Modp]\!]^{c,w,S,g}$
a. defined iff $Modp-$verifiers in $S' \neq \emptyset \wedge Modp-$falsifiers in $S' \neq \emptyset$;
(uncertainty condition)
if defined, =1 iff
b. $\exists w' \in S' : [\![Modp]\!]^{c,w,S',g} = 1 \wedge$
(doxastic assertion)
c. $\wedge Modp-$verifiers $>_{DES_{a,w}} Modp-$falsifiers
(preference assertion)

Since *Modp* verifiers are the same as *p* verfiers (see Anand and Hacquard (2013) for a discussion of this point), a sentence such as *John hopes that it might be raining* carries an **uncertainty presupposition** (that there is a non-trivial subset of John's belief worlds where it is raining and a non-trivial subset where it is not raining); it makes a **doxastic assertion** (that there is at least some world compatible with John's beliefs where it is raining); and, finally, it also makes a **preference assertion** (that rain is more desirable to John than no rain). Crucially, the incompatibility between *hope* and *must* is explained away as a contradiction: *#John hopes that it must be raining* is ruled out as a contradiction between the doxastic assertion (that in all of John's doxastic worlds it is raining) and the uncertainty presupposition requiring John's doxastic state to be compatible with no rain.

Dubitative *doubt* receives a very similar semantics.

(13) $[\![$**a doubts that** $\phi]\!]^{c,w,S,g}$
   a. defined iff $\phi-$verifiers in $S' \neq \emptyset \wedge \phi-$falsifiers in $S' \neq \emptyset$;
      (uncertainty condition)
      if defined, =1 iff
   b. $\exists w' \in S' : [\![\phi]\!]^{c,w,S',g} = 1 \wedge$
      (doxastic assertion)
   c. $\wedge \phi-$falsifiers $>_{PROB_{a,w}}$ $\phi-$verifiers
      (preference assertion)

Just like in the case of *hope* and *fear*, embedding necessity modals under *doubt*, as in *#John doubts that it must be raining*, generates a contradiction between the uncertainty presupposition (requiring that John's doxastic state be compatible with rain and no rain) and the doxastic assertion (that John's doxastic state entails that it must be raining). In the next section, I will discuss some challanges for Anand & Hacquard's proposal.

3. Challenges

There are two challenges that one might raise to challenge the type of proposal defended by Anand and Hacquard. The first problem concerns the analysis of attitude verbs that show a mixed behavior with respect to the embeddability of epistemic modals, i.e. emotive doxastic and dubitative attitudes. In particular, this problem challanges the uncertainty presupposition that is essential in Anand and Hacquard's story to derive the unacceptability of embedded necessity modals. The second problem is a more general worry about Yalcin's "copying" analysis of the embedded epistemic modals when applied to the cases introduced above. Let us begin with the **uncertainty presupposition problem**.

3.1. The uncertainty presupposition problem

There is an immediate prediction that the uncertainty presupposition story makes, i.e. that a negated sentence with *doubt* should also carry the uncertainty presupposition. However, this prediction is not fulfilled, as (14) clearly shows.

(14) John doesn't doubt that Mary will win the race. He is certain that she will.

Similarly for *fear*: a negated sentence with this attitude should still carry the presupposition that the subject's doxastic state is compatible with both the prejacent and its negation. However, (15) shows that this is not the case.

(15) The police no longer fear that John's death was a homicide; they are certain that it was an accident.

One could argue that with negation, the uncertainty presupposition is locally accomodated to avoid inconsistency, along the lines of (16).

(16) NOT(John is uncertain about whether Mary will win the race) John doubts that Mary will win the race.

The problem with this story is that we think of local accomodation as a "rescuing" mechanism, a mechanism that is called upon to avoid a contradiction. What is troubling about the (alleged) uncertainty presupposition is that it is *always* incompatible with the meaning of negated *doubt*, regardless of any explicit sentence contradicting it. Compare (14) to (17).

(17) John doesn't doubt that Mary will win the race.

What (17) shows is that, if there is a contradiction, it is not caused by the continuation in (14) but by the meaning of negated *doubt* itself. Anand and Hacquard's uncertainty presupposition is anomalous in that it is never consistent with a negative assertion, a logical environment that we standardly take to be transparent to presuppositions. Nor can such a presupposition be detected in the other two environments we typically resort to to identify presuppositions.

(18) a. A: Does John doubt that Mary will win the race?
B: Not at all, he's certain that she will.

(19) a. John might know that it is raining outside. But if he (still) doubts that it is, then he will open the window.

The conclusion is that the crucial piece of Anand and Hacquard's account of the distribution of necessity epistemic modals embedded under emotive doxastics and doubitatives is problematic and, as such, it undermines the whole proposal.

3.2. Epistemic flavor

Suppose Mary's colleagues have just returned from a walk outside and they tell her that there is a snowstorm outside. Since it's July, Mary doesn't believe them and insists that it can't be true. They tell her to go to the nearest window and look outside. Mary does and sees the snowstorm. Her colleagues can report Mary's belief with (20b) but not with (20a).

(20) a. #Mary finally believes that there must be a snowstorm outside.
b. Mary finally believes that there is a snowstorm outside.

Anand and Hacquard's story assumes a standard semantics for the epistemic modal, where the modal is treated as a quantifier over possible worlds restricted by an epistemic accessibility function (called "conversational background" in Kratzer's system) as shown in (21).

(21) $[\![\textbf{must}]\!]^{w,f} = \lambda p_{<st>}.\forall w' \in \bigcap f(w) : [p(w') = 1]$

The modal base of the modal is $\bigcap f(w)$, where f is the epistemic accessibility function. Combining this semantics with Yalcin's proposal that, when embedded, the modal base of an epistemic modal is inherited from the modal base of the higher attitude, it follows that, when embedded under an attitude verb, an epistemic modal loses its modal base and, therefore, its epistemic flavor as well. However, the contrast between (20a) and (20b) shows that this is inaccurate: the epistemic flavor of the modal is retained. It looks like we have a choice to make: either we abandon Yalcin's idea (as applied to the problem we are concerned about in this paper) or we abandon the standard semantics for the modal. In what follows I am going to explore the latter option. The tentative conclusion will be that this is not an unproblematic solution after all.

An obvious alternative to the standard semantics for epistemic *must* is the proposal in von Fintel and Gillies (2010), according to which *must* has a strong semantics (quantifies over all worlds in which the speaker's direct evidence is true) but carries an "unsettledness" presupposition, according to which the speaker's direct evidence does not settle the truth of the prejacent.

(22) Strong *must* + Evidentiality.
Fix a c-relevant kernel K:
a. $[\![\textbf{must } \phi]\!]^{c,w}$ is defined only if K does not directly settle $[\![\phi]\!]^c$
b. $[\![\textbf{must } \phi]\!]^{c,w} = 1$ if $B_K \subseteq [\![\phi]\!]^c$
where $B_K = \bigcap K$ and K whatever direct information is available to the speaker.

However, we are faced again with the challenge of presuppositions disappearing all too easily, as shown in (23) and (24b).

(23) A: Do the police believe that the murderer might be a woman?
B: #Hey, wait a minute! The police don't believe that their evidence doesn't settle whether the murderer is a woman.
B′: No, they have ruled that out.

(24) a. John doesn't believe that the keys might be in the car.
von Fintel & Gillies: $>>$ John believes that K_J does not directly settle whether the keys are in the car.
b. John doesn't believe that the keys might be in the car since he saw them on the kitchen table just now.

One might hold that (24b), just like the cases we discussed above, is acceptable because the unsettledness presupposition is locally accomodated in the scope of negation. However, consider the question below.

(25) A: Does the detective believe that the murderer might be a woman?
a. B: Not at all. He is certain that the murderer is a man.
b. B: Yes. In fact, he is certain that the murderer is a woman.

Both answers are fine. A defender of the unsettledness presupposition could explain the possibility of the negative answer in (25a) as the result of local accommodation. But explaining the positive answer in (25b) is harder. Locally accomodating the presupposition in the scope of the question operator would generate the question in (26).

(26) Is it the case that (**the detective believes that his evidence does not directly settle whether the murderer is a woman** and it is consistent with his doxastic state that the murderer is woman)

However, positively answering (26) entails "endorsing" the presupposition and as such it should be in contradiction with the continuation in (25b).

The conclusion is that (i) if we adopt a Kratzerian semantics for epistemic modals combined with the Yalcin/Anand & Hacquard semantics in (8) we cannot explain the contrast in (20) and (ii) if we adopt the semantics in (8) combined with a presuppositional story like the one proposed by von Fintel & Gillies, we run into the projection problems just described. The source of these difficulties is, I claim, the semantics in (8).

4. Constraints on embedded V-to-C movement in German

This section is about embedded V-to-C sentences in German, an apparently unrelated phenomenon that shows restrictions very similar to the restrictions on embedding epistemic modals. The V-to-C data discussed in this paper are from Truckenbrodt (2006). The V-to-C phenomenon has some of the properties of what Dayal and Grimshaw call "quasi-subordination" clauses which show properties of both main and subordinate clauses (Dayal and Grimshaw (2009)). V-to-C clauses have also been said to have assertive illocutionary force (e.g. Gärtner (2002)). In what follows, we will look at V-to-C sentences embedded under four kinds of attitudes and operators. Following the classification established in the V-to-C literature, these four groups are: (i) doxastic and speech act verbs, (ii) desiderative verbs, (iii) negation and inherently negative verbs such as *doubt*, and (iv) emotive doxastic verbs such as *hope*. By looking at these two phenomena in parallel, we will see that embedded German V-to-C clauses pattern like epistemic modals with respect to groups (i) and (ii) but show a split behavior with respect to groups (iii) and (iv): embedded V-to-C patterns like possibility epistemic modals with respect to emotive doxastics but like necessity epistemic modals with respect to negative or negated attitudes. The first observation is that V-to-C clauses in German can be embedded under doxastic verbs, speech act verbs, and so-called verbs of cognition.

(27) a. Maria glaubt, Peter geht nach Hause.
Maria believes, Peter goes to house
Maria believes that Peter is going home.
b. Maria behauptet, Peter geht nach Hause.
Maria claims, Peter goes to house
Maria claims that Peter is going home.
c. Maria träumt, Peter geht nach Hause.
Maria dreams, Peter goes to house
Maria dreams that Peter is going home.

V-to-C sentences cannot be embedded under desiderative verbs.

(28) *Maria will, sie ist in diesem Fall in Berlin.
Maria wants, she is in this case in Berlin
Maria wants to be in Berlin in that case.

V-to-C can occur embedded under an emotive doxastic predicate like *hoffen*, "to hope". However, V-to-C cannot occur embedded under an inherently negative verb like *zweifeln*, "to doubt", or under a negated attitude verb as in (30b).

(29) Maria hofft, sie ist in diesem Fall in Berlin.
Maria hopes, she is in that case in Berlin
Maria hopes that she is in Berlin in that case.

(30) a. *Hans bezweifelt, Peter geht nach Hause.
Hans doubts, Peter goes to house
Hans doubts that Peter is going home.
b. *Hans glaubt nicht, Peter geht nach Hause.
Hans believes not, Peter goes to house
Hans doesn't believe that Peter is going home.

In the remaining part of this section, I will summarize Truckenbrodt (2006)'s proposal for embedded V-to-C in German. With the German facts and his apparatus in place, I will then return to the topic of embedded epistemic modals and lay down my proposal in the next section. Truckenbrodt proposes that embedding a V-to-C clause in German requires that the embedding predicate make salient a set of worlds $B_w(x)$ that represents x's doxastic (or doxastic-like) state in w, where x is the subject of the attitude. It also requires that the proposition p expressed by the embedded CP be entailed by $B_w(x)$. Following Gärtner (2002), Truckenbrodt also proposes an "absorption" requirement.

(31) Absorption:
The meaning of attitude + CP must entail $B_w(x) \subseteq p$.

To see how the proposal works, we will look at a case of grammatical embedding of a V-to-C sentence and a case of an ungrammatical embedding. The grammatical one is illustrated in (32).

(32) Maria glaubt, Peter geht nach Hause.
Maria believes, Peter goes to house
Maria believes that Peter is going home.

The two requirements introduced above are satisfied: (i) the predicate makes salient a set of doxastic-like words, i.e. $DOX_w(Maria)$ (see (33a)); (ii) $DOX_w(Maria)$ entails the proposition expressed by the embedded clause, i.e. that Peter is going home as shown in (33b).

(33) a. $B_w(x) = DOX_w(Maria)$
b. $DOX_w(Maria) \subseteq (\lambda w'.$ Peter is going home in $w')$

Since (32) asserts that Maria's doxastic state entails that Peter is going home ($DOX_w(Maria) \subseteq (\lambda w'.$ Peter is going home in w')), the assertion entails (33b) and Absorption is satisfied. A violation of Absorption is the cause of the unacceptability of V-to-C under an inherently negative verb like *bezweifeln*, "to doubt". *To doubt* (and the same applies to *bezweifeln*) is a "weak" predicate: according to Truckenbrodt, saying that *a doubts p* only requires *a*'s doxastic state to be compatible with *p*, something that we can represent as: $DOX_w(Hans) \cap (\lambda w'.$ Peter is going home in $w') \neq \emptyset$. Hence, the assertion is weaker that what V-to-C requires, i.e. that Hans's doxastic state entails that Peter is going home.

To sum up, embedded V-to-C requires that the proposition expressed by the complement clause be entailed by the doxastic state of the subject of the embedding attitude verb and this requirement cannot be weaker that what the whole sentence (matrix clause + embedded clause) asserts. In the next section we will go back to the restrictions on embedded epistemic modals and, building on the strong similarities with the restrictions on embedded V-to-C in German and on some of the insights of Truckenbrodt's proposal, we will defend a proposal that accounts for the constraints on embedded epistemic modals.

5. Back to embedded epistemic modals

I assume a standardly weak semantics for epistemic modals, along the lines of Kratzer (1981), Kratzer (1991), and following Stephenson (2007), I treat epistemic modals as being judge dependent, where the judge parameter is manipulated by an embedding attitude verb. Epistemic modals (both necessity and possibility modals) carry a doxastic presupposition requiring that the judge be in a certain (to be specified) doxastic relation to the modal statement. When embedded under an attitude verb, the latter will bind the judge parameter of the embedded epistemic modal. As a result, the doxastic presupposition will require that the subject of the attitude verb (now identified with the lower judge) be in a certain doxastic relation to the epistemic complement.[2] The meaning for both epistemic *must* ϕ and *might* ϕ are given in (34) and (35): the necessity modal presupposes that the subject believe the modal proposition, whereas the possibility modal presupposes that the subject's doxastic state is compatible with the modal statement. Similarly to the Kratzerian entries above, EPI is the epistemic conversational back-

[2] It is possible to maintain that even "unembedded" occurrences of an epistemic modal are actually embedded under a covert ASSERT operator, along the lines defended in Alonso-Ovalle and Menéndez-Benito (2010), among others. In this case, the embedded judge parameter would end up coinciding with the speaker.

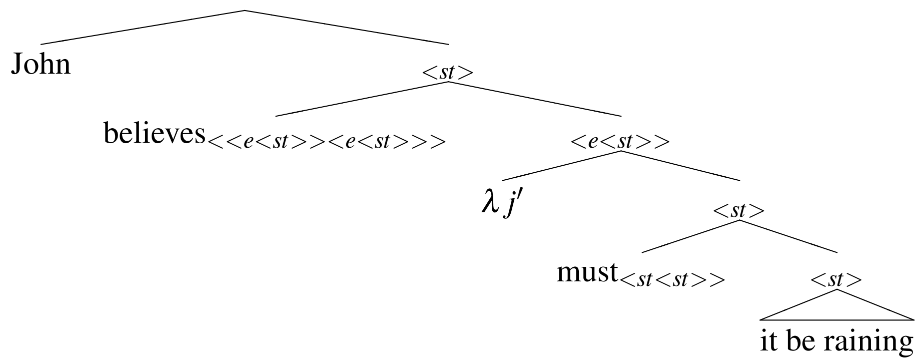
ground and ST is the stereotypical ordering source ranking the accessible worlds according to how close they are to a set of stereotypes holding in the actual world.[3]

(34) $[\![\textbf{must } \phi]\!]^{c,w,t,j}$ is defined just in case $DOX_j(w) \subseteq (\lambda w'.\ \text{must}_j(w')(\phi))$; if defined, $[\![\textbf{must } \phi]\!]^{c,w,t,j} = 1$ iff $\forall w'' \in ST_w(EPI_j(w)) : p(w'') = 1$

(35) $[\![\textbf{might } \phi]\!]^{c,w,t,j}$ is defined just in case $DOX_j(w) \cap (\lambda w'.\ \text{might}_j(w')(\phi))$; if defined, $[\![\textbf{might } \phi]\!]^{c,w,t,j} = 1$ iff $\exists w'' \in ST_w(EPI_j(w)) : p(w'') = 1$

To illustrate this part of the proposal, take the case of the attitude verb *believe*, as in *John believes that it must be raining*. The structure shows that the judge parameter for the epistemic modal is abstracted over so that it can be manipulated by *believe*. As a result of this operation, the judge parameter of the modal is bound by the subject of the doxastic attitude.

(36)



Following Gärtner's and Truckenbrodt's proposal, I will adopt a variant of their Absorption principle. As shown in (37), this principle requires that the meaning of the attitude + CP be at least as strong as the doxastic presupposition of the epistemic modal. This principle rules out cases where the doxastic condition is stronger than (asymmetrically entails) the assertoric meaning of the complex sentence.[4]

(37) *Absorption Principle*
The doxastic presupposition must not be stronger that the meaning of attitude + CP.

When the meaning of attitude + CP and the doxastic presupposition are inconsistent, the sentence can be rescued if it is possible to locally accommodate the presupposition.

In what follows, we will go through the three types of embedding predicates we discussed above: doxastic-like predicates, desiderative predicates; emotive doxastic and dubitative verbs.

[3]The proposal sketched in this section of the paper shares some features with the proposal in Crnič (2014). The two proposals were developed independently.

[4]I assume that cases where the presupposition and the assertion are inconsistent are ruled out on independent grounds.

5.1. Embedding epistemic modals under different types of attitude verbs

The doxastic type is unproblematic: recall the observation that both necessity and possibility modals can be embedded under this kind of predicate. Here is an example discussed above.

(38) John believes that the keys must be in the car.

The doxastic presupposition is that $DOX_J(w) \subseteq (\lambda w'.$ the keys must be in the car in $w')$ and, since the assertion is the same, Absorption is satisfied and the doxastic condition is "absorbed". Note that in this proposal, (38) both presupposes and asserts that John believes that the keys must be in the car. This is not unprecedented, though: for example, consider the following sentences.

(39) a. The king of France exists.
b. God exists.

(40) If John believes that the king of France exists, ...

In (39a), assuming a presuppositional analysis of the definite article, the presupposition of the definite description is that there exists a King of France, and the assertion is that he exists. Assuming the view according to which proper names presuppose the existence of their reference, (39b) presupposes that God exists and it asserts just that. (40) is a different case. Here, the presupposition triggered again by the definite article is that a King of France exists and, since it is embedded under the attitude *believe*, it is John's doxastic state that is required to entail that there exists a King of France: someone uttering the conditional antecedent in (40) would seem to be presupposing exactly the content of the antecedent itself. Since whether John's doxastic state entails that a King of France exists is precisely the content of the conditional supposition, the presupposition has been argued to be is suspended or locally accommodated. We leave the exact nature of this process aside. What we are interested here is merely pointing out that the identity of presupposition and assertion is not unique to (38).

The emotive doxastic and dubitative predicates are more challenging: they allow possibility but not necessity modals. Let's begin with the former type.

(41) a. John fears that Mary may/might have known the killer.
b. #John fears that Mary must have known the killer.

I assume here that *to fear* has a doxastic assertoric component according to which *a fears that p* asserts that $p \cap DOX_\alpha(w) \neq \emptyset$. *To fear* also has a (un)desirability component (that p is less desirable than $\neg p$ to the attitude's holder) but since this component is not doxastic, I am leaving the issue of its precise status aside in the present discussion.[5] Now, let's begin with the unacceptability of embedded *must*. As we can see in (42), the assertion (in (42a)) is weaker than the doxastic presupposition (in (42b)). Therefore, Absorption fails.

[5] One possibility is that the (un)desirability component of *fear* is presupposed. A question like (i) is interpreted as a question about the possibility of a certain eventuality (as in (a)) and not as a question about its desirability (as in (b)):

(42) a. $DOX_J(w) \cap (\lambda w'.\ \text{must}_J(w')(\lambda w''.\text{the keys are in the car in } w'')) \neq \emptyset$
b. $DOX_J(w) \subseteq (\lambda w'.\ \text{must}_J(w')(\lambda w''.\text{the keys are in the car in } w''))$

Not with *might*, however. The doxastic presupposition (in (43b)) requires that John's doxastic state be compatible with the embedded clause; hence, it is not stronger than the assertoric content of *fear* + CP. In other words, the doxastic presupposition only requires that there be some doxastic worlds where the relevant evidence/knowledge is true and the keys are in the car. Embedding *might* under *to fear* satisfies Absorption because the presupposition is identical to the assertion in (43a).

(43) a. $DOX_J(w) \cap (\lambda w'.\ \text{might}_J(w')(\lambda w''.\text{the keys are in the car in } w'')) \neq \emptyset$
b. $DOX_J(w) \cap (\lambda w'.\ \text{might}_J(w')(\lambda w''.\text{the keys are in the car in } w'')) \neq \emptyset$

Dubitative verbs such as *to doubt* show the same restrictions as emotive doxastic attitude verbs, i.e. they are compatible with possibility but not necessity epistemic modals.[6] The relevant examples are repeated below.

(44) a. John doubts that Mary may/might have known the killer.
b. #John doubts that Mary must have known the killer.

I will assume that the doxastic assertoric content in a sentence like *a doubts that p* is that *a*'s doxastic state does not entail *p*: $\neg(DOX_\alpha(w) \subseteq \phi)$ ($\equiv \neg\phi \cap DOX_\alpha(w) \neq \emptyset$).[7] Let's begin with embedded *must*: as we can see in (45), Absorption fails because the assertion in (45a) and the doxastic presupposition in (45b) are inconsistent.

(45) a. $DOX_J(w) \cap (\lambda w'.\neg\text{must}_J(w')(\lambda w''.\text{the keys are in the car in } w'')) \neq \emptyset$
(it's doxastically possible that it is not epistemically necessary that the keys are in the car; i.e. it's possible that it is consistent with J's knowledge that the keys are not in the car)
b. $DOX_J(w) \subseteq (\lambda w'.\text{must}_J(w')(\lambda w''.\text{the keys are in the car in } w''))$
(it is doxastically possible that it is epistemically necessary that the keys are in the car)

(i) Do you fear that the Raptors will lose?
a. Do you think it's possible that the Raptors will lose?
b. Do you find it undesirable that the Raptors will lose?

The semantics for *fear* might then look like this:

(ii) $[\![\alpha \textbf{ fears that } \phi]\!]$ is defined only if $\phi <_{DES,\alpha} \neg\phi$; if defined, = 1 if $\exists w' \in DOX_\alpha(w) : \phi(w') = 1$

This would also explain the judgment in (15).

[6]It might be that *fear* and *be afraid* have slightly different semantics, but for reasons of space I cannot explore this possibility here.

[7]This seems a fairly weak semantics for *doubt* since intuitively an utterance of *a doubts that p* conveys that *a* believes *p* to be somewhat unlikely. Whether this "unlikelihood" meaning should be part of the assertoric content of the sentence, is not clear. The verb *to doubt* seems to have an evidential component, which might be responsible for this stronger interpretation. A more detailed investigation of the meaning of this predicate is needed.

When the embedded modal is a weak modal (*might* or *may*), Absorption succeeds because the weakness of the modal weakens the whole doxastic condition, as shown in (46b).

(46) a. $DOX_J(w) \cap (\lambda w'.\neg(\text{might}_J(w')(\lambda w''.\text{the keys are in the car in } w'')) \neq \emptyset$
b. $DOX_J(w) \cap (\lambda w'.(\text{might}_J(w')(\lambda w''.\text{the keys are in the car in } w'')) \neq \emptyset$

The doxastic presupposition in (46b) requires that John's doxastic state be compatible with it being epistemically possible that the keys are in the car, while the assertion in (46a) is that it is doxastically possible that the evidence/knowledge is incompatible with the keys being in the car. Since these two components are consistent and the doxastic presupposition in (43b) is not stronger than the assertion, Absorption is satisfied.

This correctly predicts that when *to doubt* is negated, embedding *must* is possible: the assertion is that John believes that it is epistemically necessary that the keys are in the car, and this is exactly what the doxastic condition requires. A similar situation arises with embedded *might*.

5.2. Back to embedded V-to-C

Recall that embedded V-to-C patterns like embedded epistemic modals with respect to doxastic verbs and desiderative verbs but shows a split with respect to the other categories. This is summarized again in (47).

(47) a. V-to-C patterns like possibility epistemic modals when embedded under emotive doxastic verbs.
b. V-to-C patterns like necessity epistemic modals when embedded under inherently negative or negated attitude verbs.

One might try to capture the difference between German embedded V-to-C and embedded epistemic modals by proposing that embedded V-to-C in German requires Absorption to be weaker than what we proposed for epistemic modals.

(48) a. Strong Absorption (epistemic modals): the doxastic presupposition cannot be stronger than the assertion.
b. Weak Absorption (V-to-C): doxastic presupposition and assertion must be merely compatible.

I have repeated the relevant examples in (49a) and (49b). Recall that in German, a V-to-C clause can be embedded under *hoffen*, "to hope", but not under *bezweifeln*, "to doubt".

(49) a. Maria hofft, sie ist in diesem Fall in Berlin.
Maria hopes, she is in that case in Berlin
Maria hopes that she is in Berlin in that case.
b. *Hans bezweifelt, Peter geht nach Hause.
Hans doubts, Peter goes to house
Hans doubts that Peter is going home.

Let us begin with (49b). If you doubt that p, the assertion is that $\neg p$ is (doxastically) possible, while the doxastic presupposition that comes with the V-to-C configuration is that the subject believes that p. Assertion and doxastic condition are incompatible and Weak Absorption is not satisfied. Things are different with *hoffen*, "to hope": if you hope that p, the assertion is that p is (doxastically) possible. Since this is compatible with the V-to-C doxastic presupposition that the attitude's subject believes that p, Weak Absorption is satisfied.

5.3. Negated attitude verbs

Our next task is to look into the (un)acceptability of V-to-C in negated sentences and relate this discussion to the behavior of epistemic modals embedded under negated attitude verbs. The following German sentence with negation is judged unacceptable in Truckenbrodt (2006).

(50) *Hans glaubt nicht, Peter geht nach Hause.
Hans believes not, Peter goes to house
Hans doesn't believe that Peter is going home.

However, other sentences with negation are judged fine by the same author. In (51) we have a periphrastic negative form.[8]

(51) Es ist nicht der Fall dass Hans glaubt Peter geht nach Hause.
it is not the case that Hans believes Peter is going home
It is not the case that Hans believes that Peter is going home.

As for English, epistemic modals embedded under negated *believe* seems acceptable in most contexts.[9]

(52) After reviewing the evidence, the police no longer believe that it must/might be a homicide.

This is especially interesting when one compares the acceptability of (52) with the (relative) unacceptability of *doubt* + *must*. The puzzle is the following. We have argued that embedding a necessity epistemic modal under *doubt* violates (Strong) Absorption because the doxastic condition is inconsistent with the assertion. Therefore, embedding *must* under negated *believe*

[8]Judgments improve also if negation is in the quantifier *niemand* as in the following response to the question *Who believes that Peter is going home?*:

(i) NIEMAND glaubt, Peter geht nach Hause.
nobody believes Peter is going home
NOBODY believes that Peter is going home

[9]There is variability in the judgments with negation. For example, some speakers accept (i) but find (ii) rather odd:

(i) I believe that it must have been hard to write on epistemic modals.
(ii) I don't believe that it must have been hard to write on epistemic modals.

Hopefully, the accommodation story that we will tell can help towards explaining this variability.

should also fail Absorption since the assertion (that the subject does not believe p) is inconsistent with the doxastic condition (that the subject believes p). One way to resolve this tension is to propose that, when Absorption is not met, the last resort is to locally accommodate the presupposition, *if possible*. In the cases we are considering here, what rescues embedding *must* under a negated *believe* is the possibility of locally accommodating the doxastic presupposition in the scope of negation. However, this possibility does not seem available to inherently negative verbs like *doubt*, as the following contrast shows:

(53) a. Mary doesn't believe that John quit smoking because she knows that he is not a smoker.
b. ??Mary doubts that John quit smoking because she knows that he is not a smoker.

The last example suggests that, unlike negation, the inherent negative component of the verb *doubt* cannot be targeted for local accommodation. The contrast between (50) and (51) in German could be construed as also stemming from the possibility of locally accommodating the doxastic condition with the periphrastic form *es ist nicht der Fall dass* but not with postverbal *nicht*. However, more research on this is needed.

5.4. Desiderative attitude verbs

As noted by many already, neither necessity nor possibility epistemic modals can be embedded under desiderative verbs like *want* and directive verbs like *demand*.

(54) a. John wants the keys to have to be in the car. (*epistemic)
b. #John demanded that Mary must have been the murderer.

As we saw above, this contrasts with emotive doxastic *to hope* which can embed possibility epistemic modal *might* (but not necessity *must*; cf. (3) and (4)).

Anand and Hacquard attribute the impossibility of embedding epistemic modals under *want* to the non-representational nature of this attitude verb, which they claim only has a desiderative (ranking) semantics, as shown in the entry below from Anand and Hacquard (2013).

(55) $[\![\textbf{want}]\!]^{c,w,g} = \lambda p.\lambda x.\forall q \in g(C)\backslash p : p >_{des_{x,w}} q$

This move is problematic, though, since we know that it is possible, and in fact even advisable, to provide a semantics for *want* which includes a doxastic component (Stalnaker (1984), Asher (1987), Heim (1992)). Below is a possible entry for *want*, modeled after Heim (1992). There is no reason to believe that the subject's doxastic state would not be made salient by (56).

(56) $[\![\textbf{want}]\!]^{c,w,g} = \lambda p.\lambda x.(DOX_x(w) \cap p) <_{DES_{x,w}} (DOX_x(w) \cap \neg p)$

There is, however, an interesting difference between *to hope* and *to want* which might be relevant in explaining their different behavior with respect to the embeddability of epistemic modals. Consider the following examples.

(57) a. John wants Mary to win the game.
b. John wants Mary to have won the game. (somewhat strange)
c. John hopes that Mary will win the game.
d. John hopes that Mary won the game.

Want, but not *hope*, is typically future-oriented (and more agentive), and if (57b) is acceptable at all, the verb *want* seems to be interpreted as synonymous to *hope* (with no agentivity and no futurity). Note that the majority of verbs that do not allow embedded epistemic modals have a future orientation: desiderative verbs (*want*, *wish*); directive verbs like commands (*command*, *order*), permissions (*allow*, *permit*), and prohibitions (*forbid*, *ban*); "future" verbs like *promise*. Note as well that if a "future" verb can take a non-future complement, then it does allow an epistemic modal (*expect*, *guess*).[10] Thus, what would explain the incompatibility of *want* and epistemic modals is not the lack of a representational component but its future orientation, which is somehow incompatible with epistemic modal verbs.[11]

6. Open questions and conclusion

One phenomenon that seems to share some features with embedded epistemic modals is *slifting* (Ross (1975), Grimshaw (2011), Reis (1996), Wagner (2004)) illustrated in the following example from Grimshaw (2011).

(58) Mary, they say / I'm sure / it's clear / the teacher explained to me, is a talented singer.

The phenomenon of slifting has been already connected to embedded V-to-C by Scheffler (2009): V2 embedding and slifting are possible with verbs of saying, belief, and verbs like *hope* and *fear*; neither one is possible with factive verbs, downward epistemic verbs, desiderative verbs like *want*, and negative verbs like *doubt*. One of the contributions of the present paper is to highlight that the constraints on embedded V-to-C (and slifting) show striking similarities to the constraints on the embeddability of epistemic modals. One open question is whether the proposal defended here can be extended to the slifting cases. A second issue that one might explore in the future is the issue of cross-linguistic differences. Anand and Hacquard's paper offered some cross-linguistic experimental data but there is more variability than is conceded by the generalizations the authors take their data to support. The strongest variability I found is in the area of emotive doxastic and dubitative verbs. In addition to finding that a not marginal number of English speakers accept necessity epistemic modals under *hope*, *fear*, and *doubt*, I have encountered varieties of languages that accept necessity epistemic modals under *fear* and *doubt*. Below are some examples from Russian and Bengali. The acceptability contrast between (59a) and (59b) in Russian correlates with the different modal expression in the em-

[10] One might follow Abusch (2004) and her treatment of futurate predicates in assuming that the LF representation in (ia) for the complement of future oriented attitudes contains a future shifting operator as in (ib).

(i) a. *want*: $[_{CP}\ \lambda n\ [_{IP}\ n\ [FUT[_{CP}\lambda n\ [_{IP}\ n\ VP]]]]]$
b. $[\![\mathbf{FUT}]\!] = \lambda P.\lambda t.P((t,\infty))]$

[11] See Homer (2010) for more on the relation between epistemic modals and tense operators.

bedded clause: in (59b) an adverbial form is used. Note, also, that the modal expression used in Bengali is also adverbial.[12,13]

(59) Russian

a. ??Ivan somnevaetsja chto Masha dolzhna byt' doma
Ivan doubts-refl that Masha must-F-sg to-be home
John doubts that Mary must be home

b. Ivan somnevaetsja chto Masha dolzhno byt' doma
Ivan doubts-refl that Masha must-Adv(N-sg) to-be home
John doubts that Mary must be home.

(60) Bengali

a. Johner bhoe ∅ je niscoi norohotto hoeche
John-gen fear COP COMP certainly homicide happen-Pfv-3.pres
John is afraid that a homicide must have occurred.

To conclude, I have shown that the restrictions on which attitude verbs can embed epistemic modals bear a strong resemblance to the restrictions on embedded V-to-C movement in German, and that these two phenomena can be given similar explanations. I have proposed that epistemic modals presuppose that their judge (the owner of the epistemic state we quantify over) believes the modal claim. When embedded under attitude verbs, the judge parameter of the epistemic modal is bound by the attitude's subject and, as a result, it is the attitude's subject that is required to believe the embedded modal statement. I argued that the semantics proposed by Anand and Hacquard (2013) for emotive doxastic and dubitative verbs to explain the impossibility of embedding necessity epistemic modals is problematic. Instead, I have argued that Absorption can explain these restrictions once a minimal semantics for these attitude verbs is assumed. A weaker Absorption principle explains the restrictions on embedded V-to-C in German. Open questions remain, in particular about the incompatibility between future operators and epistemic modals (as discussed in the section on desiderative verbs), the relation between embedded epistemic modals/V-to-C and slifting, the behavior of factive predicates (which we haven't talked about in this paper), as well as the nature of Absorption itself.

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[12] For some Italian speakers these embedding are also acceptable, even though on a scale of acceptability, a bit degraded compared with the corresponding weaker modal cases. Note also that Italian uses regular modal verbs.

[13] Thanks to Julie Goncharov and Neil Banerjee for their Russian and Bengali judgments respectively.

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The temporal presuppositions of Somali definite determiners[1]

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Abstract. Nominal temporal markers (NTMs) locate the time at which the property or relation denoted by a nominal holds of an entity (Enç, 1981). What distinguishes Somali from other languages with overt NTMs is that these markers are also definite determiners. We follow up on the observation that there is a contrast in the interpretation of definite determiners -KA and -KII, and propose that this contrast is a difference in the scalar implicatures triggered by each determiner. This difference is linked to an interaction between the temporal presuppositions of -KA and -KII and the lexical semantics of their NP complement. Our analysis captures the fact that these determiners do not obey common diagnostics of "nominal tense" (Tonhauser, 2007), while accounting for the data in Lecarme (1996) as well as the more recent proposal (Lecarme, 2008, 2012) that -KII and -KA track the (in)visibility of the entity denoted by the DP.

Keywords: Somali, determiners, definiteness, nominal TAM, presupposition

1. Introduction

The aim of this paper is to explain the contrast between what has been described in the literature as the "regular" definite determiner -KA (Green et al., 2015) and the "remote," "tensed" or "evidential" definite determiner -KII (Lecarme, 1996, 2008, 2012) in Somali. A comparison between Somali -KII and Guaraní *-kue*, as discussed in Tonhauser (2007), illustrates that the current take on nominal temporal markers (NTMs) cannot fully account for the Somali data. We propose that a scalar implicature based account, in line with the work of Thomas (2014) for Mbyá Guaraní, and Altshuler and Schwarzschild (2013) on cessation implicatures in English, can capture the semantic contribution of Somali -KII. Our account relies on novel data involving contexts where this contrast obtains, and ones where it does not.

The choice between -KA or -KII for Somali nominals can give rise to temporal interpretations, as well as to (in)visibility readings, by which we mean that the denotation of the DP is judged to be visible or invisible to the discourse participants. We claim that the these contrasts are due to a competition between -KA and -KII. Assuming that Somali NTMs behave like a regular tense system, similarly to Mbyá Guaraní (Thomas, 2014), we propose that -KA requires the NP predication to be true of an individual at topic time, while -KII requires it to be true at some salient time preceding topic time. Based on the *Open Interval Hypothesis* proposed by Altshuler and Schwarzschild (2013) (see also Cable 2017), whereby a present stative sentence asymmetrically entails its past tense variant, we assume that a sentence with a -KA marked nominal asymmetrically entails a sentence with its -KII marked counterpart. Thus, the use of -KII generates the implicature that the -KA alternative is false, resulting in the aforementioned

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interpretative contrasts. We speculate that contexts where the contrasts are not observed are ones where the relevant implicatures are not generated.

The paper is structured as follows. Section 2 provides background information regarding the elicitation, novel data confirming that both -KA and -KII pattern like definite determiners, and the core data regarding the relevant semantic contrasts between the two determiners. Section 3 focuses on nominal tense as discussed in the literature and on the key properties of nominal temporal markers identified by Tonhauser (2007) for Guaraní, namely precedence, change of state and existence. Section 4 discusses novel data which illustrate that two of three properties of Guaraní *-kue*, change of state and existence, do not hold of Somali -KII. In section 5, we present the core generalization and argue in favor of a competition based account for the two Somali definite determiners. Section 6 concludes.

2. Background Information

2.1. Elicitation

The data discussed in this paper was mainly collected from a primary consultant, who self reports as a native speaker of Standard Somali. The elicitations took place at the East African Cultural Center (EACC) in Springfield, Massachusetts, between September 2015 and May 2016. Four other occasional attendees of the EACC contributed on site, and a linguistically trained native speaker from Minnesota contributed by e-mail.

2.2. The definiteness of -KA and -KII

Somali has two noun classes, referred to in the literature as the masculine and the feminine (Saeed, 1993, 1999; Green et al., 2015). Masculine nouns are suffixed with morphemes whose initial segment is /k/ (phonologically realized as [k], [g] or [h] and noted K) as shown in (1a). As illustrated in (1b), for feminine nouns the initial segment of the suffix is /t/ (phonologically realized as [d], [dh], [sh] and noted T). All of the instances of the allomorphs in (1) are referred to as -KA and -KII throughout the paper.

(1) a. *aqal-**ka***, *aqal-**k**ii*, *telefoon-**ga***, *telefoon-**g**ii*
house-KA house-KII telephone-KA telephone-KII
the house, the telephone (masculine)

b. *shimbir-**ta***, *shimbir-**tii**, qorrax-**d**a*, *qorrax-**d**ii*
bird-KA bird-KII sun-KA sun-KII
the bird, the sun (feminine)

As previously mentioned, both -KA and -KII are claimed to be definite in the literature (Saeed, 1993; Lecarme, 1996; Green et al., 2015). Our data confirms that -KA and -KII marked nominals pattern like definites; consequently, for the purposes of this paper, they will be refered to as definite determiners. For a different take on definiteness in Somali and for arguments in favor of the existence of a null definite determiner which is taken to be responsible for the definite interpretation of the nominals suffixed with -KA and -KII, see Özyıldız and Ivan (2017).

According to Heim (1983) and Matthewson (1998), definite noun phrases refer to familiar, previously introduced discourse referents. This holds true of both -KA and -KII marked NPs, as shown in example (2). Both definite determiners allow anaphoric reference to the boy introduced in the preceding piece of discourse.

(2) ANAPHORIC REFERENCE
Context: *A boy and a girl came. The boy laughed.*

a. Wiil iyo gabadh baa yimid. Wiil-**kii** baa qoslay.
boy and girl FOC came. boy-KII FOC laughed

b. Wiil iyo gabadh baa yimid. Wiil-**ka** ayaa qoslay.
boy and girl FOC came. boy-KA FOC laughed

'A boy and a girl came. The boy laughed.'[2] [03/19/2016]

Furthermore, both -KA and -KII can refer to unique NPs in both immediate and larger situations. In (3), where the sun is a unique entity, the use of either determiner is grammatical.

(3) REFERENCE TO UNIQUE NPS
Context: *Axmed was working home all day. He decides to go out and sees the sun.*

Marku baxay wux-uu arkay qorrax{**-ka/-kii**}.
when went out FOC=3S saw sun-KA/-KII
'When he went out, he saw the sun.' [03/07/2016]

According to Schwarz (2009, 2013), in languages with multiple definite determiners, these determiners can be either *weak* or *strong*.[3] Weak definite determiners cannot be used anaphorically, only being able to refer to NPs that are unique in the context, while strong definite determiners can also have anaphoric uses as in (2). The fact that both -KA and -KII are grammatical in example (2), which tests for anaphoricity, and (3), which tests for non-anaphoric reference, suggests that the strong/weak determiner distinction is not at play in regulating the distribution of Somali definite determiners. The difference between the two seems to lie elsewhere.

2.3. Core data

Work by Lecarme (1996, 2004, 2012) argues that *-kii* is a "tensed" determiner denoting the past tense (for arguments against this analysis, see Tonhauser (2006: pp. 325–333)). The temporal analysis of -KII is motivated by data like (4) (Lecarme, 1996: ex. (10), p. 161), where -KA is ungrammatical when referencing a past year. Lecarme argues that *sannad-kii* receives a temporal past interpretation, thus rendering it ungrammatical with future-oriented adverbials.

[2]It should be noted that different focus markers are used in the two subexamples. We speculate that this difference is due to the fact that the counterpart of (2a) with -KA, *wiilka baa*, is morphologically ill-formed.

[3]This is not the weak/strong determiner distinction from Barwise and Cooper (1988).

(4) a. sannad-**ka** *dambe*
year-KA next
'next year'

b. sannad-**kii**/*-**ka** *hore*
year-KII/*-KA before
'last year'

Lecarme (1996, 2012) notes that -KII can also have temporal interpretations on nouns denoting a set of individuals, such as 'student.' We replicated this effect with the NP 'president.' In a context where Barack Obama is the current president, like in (5), the DP *madaxweynaha*, which bears -KA, may only refer to Obama, and not to Bush—who was the salient former president in the context. On the other hand, *madaxweynihii*, with -KII, may only refer to Bush, and not to Obama. Both sentences in (5) were judged true with this reference scheme. They were judged false when -KII was used in (5a) and -KA, in (5b).

(5) TEMPORAL CONTRAST between -KA and -KII
Context: *The year is 2016 and Barack Obama is the president of the United States.*

a. Madaxweyna**ha** wux-uu ku nool yahay guriga cad.
president-**KA** FOC=3S at lives house white
'The president lives in the White House.' ≈ **Barack Obama**

b. Madaxweyni**hii** wux-uu ku nool yahay Texas.
president-**KII** FOC=3S at lives Texas
'The president lives in Texas'. ≈ **George Bush** [01/30/2016]

Lecarme (2012) also identifies a "modal" or "evidential" contrast between -KA and -KII, whereby visible entities are marked with the former and invisible entities with the latter. This effect was replicated in our elicitations. In the context of a solar eclipse, the use of -KA on the NP 'sun' implies that the sun is in plain sight, whereas the use of -KII implies that the sun is eclipsed.

(6) VISIBILITY CONTRAST between -KA and -KII
Context: *During a solar eclipse. Answer to "What are you doing?"*

Wax-aan fiirinayaa cadceed**-da/-dii**.
FOC=1S watching sun-KA/-KII
I'm watching the sun.

a. Inference with -KA: The sun is visible.
b. Inference with -KII: The sun is eclipsed.
c. -KII is odd if the sun is visible; -KA is odd if the sun is eclipsed. [01/30/2016]

The use of -KII on an NP corresponding to a temporary state, like 'rain,' gives rise to the same effect. If the rain is ongoing and visible, then only -KA is felicitous.

(7) Context: *It's raining and I'm outside.*

Roob{**-ka**/#-kii} baan eegayaa
rain-KA/-#KII FOC=1S watching
I'm watching the rain. [05/11/2016]

We argue that a unified account can generate both the temporal and the invisibility readings presented in the examples above. Our proposal is laid out in Section 5. The next two sections give an overview of the properties of NTMs and argue that Tonhauser (2007)'s seminal account of Guaraní NTMs cannot be extended to Somali -KII.

3. Properties of nominal tense

The current section introduces the notion of NTMs and outlines the three properties identified by Tonhauser (2007) based on the future (*-rã*) and past (*-kue*) nominal markers of Guaraní. These three properties are *precedence*, *change of state* and *existence*.

3.1. Nominal Tense

An important first observation is that both NPs and VPs can locate the time at which a property is true of an individual. For instance, in (8), the past tense 'watched *Harry Potter*' indicates that the activity is true of *x*, at some interval of time, *t*, which is a subpart of *yesterday*. On the other hand, 'linguistics grad student' is true of *x*, at some time, t', which includes *yesterday*, the property of being a linguistics grad student generally spanning from 2 to 5 years.

(8) *Yesterday*, a linguistics grad student *watched* Harry Potter.

In (8) there is an overlap between the time interval at which x is a *linguistics grad student* and the time interval during which x *watches Harry Potter*. However, NPs and VPs within the same sentence need not hold true at the same time. Consider (9) where, in a context where all of the contextually relevant individuals stop being students, the property of being a 'student' was true of the individuals in every's restrictor before utterance time, and it is false at utterance time.

(9) Every student is now a UMass graduate.

The observation that verbal tense does not affect the temporal interpretation of noun phrases was first made by Enç (1981). She proposed that this can be captured by means of *nominal tense*. One morphological realization of nominal tense and aspect is represented by the morphemes in (10) which restrict the time interval at which the nominal they attach to is true.

(10) *ex*-soldier, *former* friend, *future* president, wife-*to-be*

Although subtly distinct from the phenomenon illustrated in (9), the affixes and adjectives in (10) point to the core intuition: the time at which the property (*soldier, friend, president, wife*) holds true of the individual is either before (*ex-, former*), or after (*future, -to-be*) topic time. According to Wiltschko (2003), semantic nominal tense is universal; the crosslinguistic difference lies in whether nominal tense is syntactically marked. In fact, overt nominal TAM (tense and aspect morphology) is rare. Nordlinger and Sadler (2004) list twelve different languages which exhibit NTMs (Lake Miwok, Halkomelem, a.o.). Somali (Lecarme, 1996), Guaraní (Tonhauser, 2007) and Tsou (Chang, 2015) are ones that have been discussed more extensively.

3.2. Guaraní nominal TAM

Tonhauser's (2006; 2007) seminal account of nominal temporal markers in Guaraní discusses the morphemes *-kue* and *-rã*. Tonhauser argues that they are nominal *aspectual* markers and identifies three properties which NTMs might be expected to display cross-linguistically. The example below illustrates that Guaraní makes use both of a future nominal temporal marker, *-rã*, and of a past one, *-kue*. It should be noted that the example, glosses and translation below are taken from Tonhauser (2007), and that the two NTMs are not equivalent to the English adjectives *future* and *former*, the Guaraní nominal temporal markers having a wider use than their English counterparts.

(11) Juan ha'e pa'i**-kue/-rã.**
Juan 3.PRON priest-KUE/-RA
'Juan is a former/future priest.' (Tonhauser (2007), ex. (8), page 836)

To capture the different properties of Guaraní NTMs, Tonhauser (2007) distinguishes between two main intervals: the NP time, t_{NP}, and the nominal time, t_{nom} (or possessive time, t_{poss}). The NP time represents the evaluation time of the entire NP, the time at which the phrase is interpreted. This generally picks out topic time. The other relevant interval t_{nom} (or t_{poss}) is the time at which the property (or relation) expressed by the noun phrase is true of the individual(s) in the relevant domain (or, in the case where the NP is relational, is true of the members of the relation). As previously mentioned, Tonhauser (2007) argues that nominal temporal (or aspectual) markers have three properties: *precedence*, *change of state* and *existence*, which are described in terms of the relations between t_{nom} and t_{NP}. These properties are outlined in the following subsections.

3.2.1. The precedence meaning property

Perhaps the most salient meaning property of NTMs in general and of *-kue* and *-rã* is that they encode a precedence relation: respectively a past-time oriented relation and a future-time oriented one. In (12), the use of *-kue* conveys that the time at which the property of being a *priest* holds true of the individual precedes t_{NP}, while the use of *-rã* conveys that the predicate holds true of the individual after t_{NP}, and, consequently, after topic time.

(12) PRECEDENCE RELATIONS

a.	priest-KUE ≈ past priest	$t_{nom} < t_{NP}$	before TT
b.	priest-RÃ≈ future priest	$t_{nom} > t_{NP}$	after TT

In the case of possessives, the precedence relation can apply either to the possessive or to the nominal itself. In (13), for instance, which is adapted from Tonhauser (2007), both the Guaraní *che-róga-kue* and the English *my former house* are ambiguous between two possible readings. One interpretation is that the possessive time is located at t_{NP} (in this case, utterance time) and the nominal time, t_{nom}, precedes t_{NP}; in this instance, the speaker is looking at the ruins of their house. The second reading is one where t_{nom} overlaps with t_{NP}, but t_{poss} is located prior to the noun phrase time; here, the speaker is looking at a building which was once their house.

(13) Ko'agã a-hecha che-róga-**kue**.
now SG-see SG-house-KUE
'I am seeing my former house.' (Tonhauser, 2007: ex. (12), p. 838)

All of the occurences of *-kue* discussed in this section are parallelled by similar examples with future-oriented NTM, *-rã*. However, we will henceforth only refer to examples with *-kue*, as Somali does not have a future oriented nominal temporal marker.

3.2.2. The change of state meaning property

Much like the English *former*, Guaraní *-kue* also encodes a change of state meaning, namely, the NP predication (or relation) ceases to hold true of an individual *x* before t_{NP} (or topic time).

(14) a. *Albus is a *former* teacher and he is *still* a teacher
b. Albus is a *former* teacher and now he's a teacher *again*

The examples in (14) (which can also be replicated for Guaraní *-kue*, see Tonhauser (2007: exx. (13/14), p. 838)) illustrate that the nominal predication, *teacher*, is true prior to t_{NP} and that it *ceases* to be true prior to t_{NP}. Furthermore, (14b) shows that neither the English *former* nor the Guaraní *-kue* encode that the property is *not* true at t_{NP}, but merely that it had stopped being true sometime before noun-phrase time. Albus can be a former teacher and a current teacher, the predication need not be false at t_{NP}.

Tonhauser (2007) points out that although both *-kue*, *former* and English past tense have the precedence meaning property, only the first two have the change of state property. The first utterance in (15) merely implicates that Hermione is no longer in the Hospital Wing at the time of utterance. The fact that *still* is felicitous in the second utterance illustrates that English past tense, unlike *former* or Guaraní *kue* does not semantically encode a change of state.

(15) Hermione was in the Hospital Wing last week. She is *still* there today.

The observation that Guaraní *-kue* is *not* like English past tense in this instance serves as an argument for Tonhauser (2007) in favor of the view that *-kue* and *-rã* are *aspectual* nominal markers, and not tensed. We will return to this fact in section 4, where we compare Guaraní nominal TAM to Somali -KII.

3.2.3. The existence meaning property

The third property of NTMs identified by Tonhauser (2007) is that of existence, which assumes that both t_{nom} and t_{np} should fall within the time of existence of the individuals denoted by the noun phrase. This would account for the infelicity of *-kue* in the context below.

(16) Context:
The town of San Isidro once had a priest called Jose. This man died as a priest.
\# pe pa'i-**kue** Jose
that priest-KUE Jose
'that ex-priest Jose' (Tonhauser, 2007: ex. (21), p. 842)

It should be noted that English *former* is also not felicitous in (16). The intuition is that the property of being a *former* priest was never true of *Jose* while he was alive. The only context in which 'priest'-*kue* would be felicitous is one where *Jose* stopped being a priest while alive.[4]

3.2.4. Summary: *-kue* properties

To reiterate, Tonhauser (2007) proposes that there are three distinct properties which are true of Guaraní nominal temporal markers. These properties are summarized below.

(17) *NTM properties*
1. PRECEDENCE: t_{nom} / t_{poss} precedes t_{NP} (topic time)
2. CHANGE OF STATE: the property or relation ceased to be true before t_{NP}
3. EXISTENCE: the time of the existence of *x* includes t_{nom} and t_{NP}

According to Tonhauser (2007), these three properties are individually encoded in the lexical entry of *-kue*. The lexical entry for *-kue* as applied to property NPs is given below.[5] The formal semantic analysis below, applied to the denotation of predicates, establishes that for all properties P and entities X, the property KUE(P) is true of an individual, *x*, at the noun-phrase time, t_{NP}, in a world *w* if and only if there is a time *t* that precedes the noun phrase time and *t* is the situation time of P(x) in world *w and* the noun phrase time is included in the lifetime of *x*.

(18) $\forall P\ \forall x\ [\ \text{KUE}(P)(x) = 1 \text{ at } t_{NP} \text{ in } w \text{ iff } \exists t_{nom}\ [$
$t_{nom} < t_{NP}\ \&\ \tau(P(x)) = t_{nom} \text{ in } w\ \&\ t_{NP} \subseteq \tau(x)\ ]\ ]$

Before moving on to the next section, it should be noted that both *existence* and *change of state* are hardwired into the lexical entry of *-kue*. For the intents and purposes of this paper, *-kue* behaves like English 'former,' but, as Tonhauser (2007) points out, this is a simplification.

4. Somali -KII vs. Guaraní *-kue*: -KII is not 'former'

This section tests whether the properties identified by Tonhauser (2007) for Guaraní *-kue* hold of Somali -KII. The data illustrate that although -KII has the precedence meaning property, it does not semantically encode the change of state or the existence properties. In this sense, -KII is different from *-kue* and English 'former.' Furthermore, we show that, unlike *-kue*, Somali -KII does behave like tense and it can give rise to temporal and invisibility implicatures.

[4]On the other hand, *-kue* would be felictious in the context in (16) if it applied to a possessive relation: 'our priest'-*kue* would denote a possession relation which ceased to be true.

[5]The definition of *-kue* for possessive relations is similar.

4.1. Lack of the *existence* property

The existence property refers to the fact that Guaraní *-kue* is not felicitous in contexts like the one in (16), where the property of being a priest held true of an individual right up to the moment of their death. We attempted to replicate this finding with our Somali consultants. The expectation was that if -KII had the existence property, a sentence like (19) would be infelicitous in the context given, with -KII on the subject NP.

(19) Context: *Uttered right after the current president's death…*

madaxweyni-**hii**/madaxweyna#**-ha**	wuu	dhintay
president-KII/president-KA	FOC=3S.M	died

'The president died.' [01/30/2016]

The example above illustrates that in a context where the individual picked out by the current 'president' dies *as* a president -KII is, in fact, felicitous. This is unexpected if -KII were to have the same meaning as Guaraní *-kue* and had the existence property. Furthermore, it seems that -KA is infelicitous in (19), presumably because there is no president in the context.[6] Nevertheless, the data shows that Somali -KII, unlike Guaraní, does not have the existence property.

4.2. Lack of the *change of state* property

As shown in Section 3.2.2, the property of the NP that *-kue* attaches to ceased to be true of the individual picked out by the nominal prior to the noun phrase time. In contrast, the examples in this section suggest that *-kii* does not *obligatorily* trigger a change of state inference.[7] The context and item in (20) are replicated from Tonhauser (2007: ex. (44)).

(20) Context: *Yesterday I went to a bike shop and out of all of the bikes they had I chose one for my sister. I didn't have enough money yesterday. Tomorrow I'll go back to the shop and buy the bike I chose.*

Baskiil-**ka** / Baskiil-**kii**		bari	baan	gadanaya
bike-KA	/ bike-KII	tomorrow	FOC.1S	buy.FUT

'I will buy the bike tomorrow.' [11/04/2015]

According to Tonhauser (2007), in Guaraní the change of state interpretation in the context in (20) is necessary. For her consultants, 'bike'*-kue* may only refer to a broken bike (which renders the target sentence odd in the scenario above). In Somali, both *baskiil-ka* and *baskiil-kii* are perfectly felicitous and refer to a bike which had been previously introduced in the discourse. No change of state inference is drawn in this context. Further attempts to favor Guaraní-type change of state meanings on object denoting NPs were unsuccessful.

[6] Our primary informant comments: "If he died, you cannot say *[k]a*."

[7] There is a subtle difference between "change of state" (predication ceased to be true before but may be true again at topic time) and "cessation" (predication ceased to be true and is still not true at topic time) inferences (Altshuler and Schwarzchild 2012, Thomas 2014).

(21) Context: *Shards of a broken jar are set on the table.*
Dhala-day-**dii** *(jajabkee-**dii**) miiska ayuu saaran yahay
jar-POSS.1S-KII *(shards-KII) table-KA FOC on is
'The shards of my jar are on the table.'
Intended: 'My (broken/former) jar is on the table.' [01/30/2016]

The aim of the scenario above was to get our informants to express that an object was broken solely through the use of -KII. For the purposes of this elicitation task, a broken jar was brought into the elicitation session and set in plain view, on the table between the authors and the informant. It was found that the possessive construction *dhaladaydii*, 'my jar-KII' may only refer to an intact jar. As illustrated in (21), an overt genitive construction, "the shards of the jar,"[8] must be used in order to express the broken state of the object.

The change of state inference cannot be expressed by means of -KII alone. Somali seems to express the equivalent of the English 'former NP' by using the adjective *hore* in combination with a -KII marked NP.

(22) Context: *We are talking about several students.*
Maxamed is the one who dropped out of college / graduated.
Maxamed waa arday-**dii** hore.
Maxamed DECL students-KII.PL 'former'
'Maxamed is one of the former students.' [11/04/2015]

It is unlikely, however, that the combination of -KII and *hore* is equivalent to the semantics of 'former NP,' given that our informant accepts a continuation like in (23) to the sentence in (22).

(23) *Out of the blue*
Maxamed waa arday-**dii** hore ee **wali** ardayga ah
Maxamed DECL students-KII.PL *hore* which **still** student-KA is
'Maxamed is one of the previous[9] students who is still a student.' [11/04/2015]

If anything in the semantics of -KII or of *hore* were uniformly equivalent to that of 'former,' the sentence should sound odd. This oddness is what we observe with Guaraní *kue* and English 'former.' We take this as evidence that Somali -KII does not obligatorily have the change of state property. In example (23), the behavior of Somali -KII parallels that of the English past tense in a stative sentence like (15), where a cessation inference (that Hermione is no longer in the Hospital Wing or that Maxamed is no longer a student) is triggered but is cancellable.

(15) Hermione was in the Hospital Wing last week. She is *still* there today.

[8]Similar examples obtain for possession, where "my jar-*kii*" or "my phone-*kii*" alone cannot denote a jar/phone that *used to be* mine. Transfer of possession, in these cases, can be expressed with a relative clause. Our proposal predicts that change of state inferences should not obtain with permanent properties like 'being a jar.'

[9]The word *hore* is translated in Qoorsheel (1978) as 'ahead,' 'before,' and 'former,' among other meanings.

The data explored in this section so far point to the fact that Somali -KII does not behave like English 'former' or like Guaraní *-kue*: -KII does not encode the properties of existence and change of state identified by Tonhauser (2007). While Somali -KII may be different from Guaraní NTMs, it does encode the precedence property. The following subsection further motivates the analysis of -KII as a nominal tense marker.

4.3. The temporal contrast of Somali definite determiners

The previous subsection illustrated that -KII does not obligatorily generate a change of state inference. Nevertheless, this inference does arise in certain contexts. Example (5) is repeated below. Recall that in context, *president*-KA may only refer to the current president, Barack Obama, and the use of -KA in (5b) would lead to infelicity. Similarly, *president*-KII would not be felicitous in (5a), necessarily referring to George Bush, the salient past president, in (5b).

(5) Context: *The year is 2016 and Barack Obama is the president of the United States.*

a. Madaxweyna**ha** wux-uu ku nool yahay guriga cad.
   president-**KA** FOC=3S at lives house white
   'The president lives in the White House.' ≈ **Barack Obama**

b. Madaxweyni**hii** wux-uu ku nool yahay Texas.
   president-**KII** FOC=3S at lives Texas
   'The president lives in Texas'. ≈ **George Bush** [01/30/2016]

Event nouns modified by -KII may also give rise to cessation implicatures. The example in (24) is replicated from Lecarme (2008: ex. (11), p. 204). The two sentences below were elicited during The Big E festival, an annual event in Springfield, MA, that takes place at the end of September. Crucially, (24a) can only be uttered if the exhibition is still running at Utterance Time, *exhibition*-KII being infelicitous in this scenario. The use of -KII is felicitous in (24b), where it is contextually given that the exhibition is closed at the time of speech; as in the case of (5), -KA is infelicitous if the speaker is aware that the festival ended.

(24) a. Context: *The Big E is ongoing at the time of speech.*

Bandhig-**ga** ma=ad daawatay?
exhibition-**KA** Q=2S see.2S.PAST
'Have you seen the exhibition?'

b. Context: *It is mid-October and The Big E recently ended.*

Bandhig-**gii** ma=ad daawatay?
exhibition-**KII** Q=2S see.2S.PAST
'Have you seen the exhibition?' [09/27/2015]

In (23), in section 4.2, we observed that *student*-KII does not entail a change of state, but that it gives rise to a cancellable implicature that the individual denoted by the DP is not a student at UT. However, the 'optionality' of this inference is context-dependent: compare (22) with (25), where the change of state inference is obligatorily triggered.

(25) Context: *Axmed graduated from school and got a job at a company.*
Arday-**gii/#-ga** wuxuu ka shaqayay hayad.
student-GII/-GA FOC=3S at working company
'The (former) student is working at a company.' [05/11/2016]

The choice of -KII over -KA is context dependent and it is sensitive to a temporal contrast between the two, which may give rise to a *change of state* interpretation of the target sentence. The data indicates that this is a cancellable implicature reminiscent of the use of past tense in stative sentences (see (15)).

4.4. The (in)visibility contrast of Somali definite determiners

Lecarme (2008, 2012), based on data like the one in (26), suggests that Somali definite determiners are sensitive to visibility from the perspective of the speaker: if the referent is absent from the immediate visual context, then -KII is used, whereas -KA would be inappropriate. Lecarme (2008) also notes that the contrast is not optional: the use of -KII is not felicitous if the referent is visible.

(26) a. Context: *The speaker's pen is in the drawer, invisible to the speaker.*
Qalin-kay-**gii**/*-gu meeyey?
pen-M.POSS.1S-KII/*-KA.TOP Q.is.M.S
'Where is my pen?'

b. Context: *There are multiple pens on the desk.*
Qalin-kay-**gu** waa kee?
pen-M.POSS.1S-KA.TOP DECL Q.M
'Which one is my pen?' (Lecarme, 2008: ex. (20), p.212)

This contrast was also replicated in our elicitations: *sun*-KII in (27b) may only refer to an 'invisible,' eclipsed sun, while *sun*-KA in (27a) necessarily refers to a visible sun.

(27) a. Shalay waxa=an firinayay cadceed-**da**
yesterday FOC=1S look.PAST sun-KA
'Yesterday I looked at the sun' ≈ **visible**

b. Shalay waxa=an firinayay cadceed-**dii**
yesterday FOC=1S look.PAST sun-KII
'Yesterday I looked at the sun' ≈ **eclipsed** [01/30/2016]

However, the (in)visibility contrast is not always observed. In the scenario in (28), the sun is in plain sight, yet the use of -KII is licensed. This is unexpected under Lecarme's (2008; 2012) account. Contrary with the generalization that -KII marked NPs are invisibile entities, our data illustrates that invisibility does not always pattern with the remote definite determiner.

(28) Context: *We are outside, taking a walk. The sun is shining.*
Cadce-**dii/#-da** cirkay joogta
sun-KII/#-KA sky be.at.PRES
'The sun is in the sky.'[10]

Another case where -KII refers to visible entities was that of (21), where the object in question, the jar, was in the immediate context of the informant (on the table, in front of the speaker). It seems that although invisibility readings *do* arise with -KII, they are not mandatory. Our account is sensitive to the 'optionality' of the invisibility and change of state readings.

5. Generalizations and proposal

5.1. Core generalizations

Somali encodes definiteness by means of (at least) two determiners: -KA and -KII. The choice of one over the other *may* give rise to change of state or invisibility readings. There are contexts in which these contrasts obtain (such as (5) for the temporal contrast and (6) for visibility) and contexts, like (3), where the implicatures are either cancelled or not generated. For convenience, the core data referenced throughout the paper is repeated below.

(3) Context: *Axmed was working home all day. He decides to go out and sees the sun.*
Marku baxay wux-uu arkay qorrax{**-ka/-kii**}.
when went out FOC=3S saw sun-KA/-KII
'When he went out, he saw the sun.' [03/07/2016]

(5) Context: *The year is 2016 and Barack Obama is the president of the United States.*
a. Madaxweyna**ha** wux-uu ku nool yahay guriga cad.
president-**KA** FOC=3S at lives house white
'The president lives in the White House.' ≈ **Barack Obama**
b. Madaxweyni**hii** wux-uu ku nool yahay Texas.
president-**KII** FOC=3S at lives Texas
'The president lives in Texas'. ≈ **George Bush** [01/30/2016]

(6) VISIBILITY CONTRAST between -KA and -KII
Wax-aan fiirinayaa cadceed**-da/-dii**.
FOC=1S watching sun-KA/-KII
I'm watching the sun.
a. Inference with -KA: The sun is visible.
b. Inference with -KII: The sun is eclipsed.
c. -KII is odd if the sun is visible; -KA is odd if the sun is eclipsed. [01/30/2016]

[10]Surprisingly, *sun*-KA is reportedly odd in (28), but would be felicitous in a context where the sun was rising. This is a puzzle which we leave for further research.

The data points out that the distribution of NP-KII, given in (29), is broad. It may refer to visible entities of which the NP property is true at topic time (TT), as in (3), it may refer to visible entities of which the NP property is *not true at TT*, but true at some salient time before TT, as in (5), where Bush is a former president, and, finally, as in (6), to *invisible* entities of which the NP property holds true at TT, but the entities are not visible in the topic context.

(29) DISTRIBUTION OF NP-KII
  i. entites x that are in the topic context and NP(x)=1 at topic time,
  ii. entities x that are in the topic context and NP(x)=1 at some time preceding topic time, NP(x)=0 at topic time,
  iii. entities x that are not visible in the topic context and NP(x)=1 at topic time.

With respect to NP-KA, its distribution, given in (30), is more restricted. In all of the contexts examined in this paper, -KA marked nominals referred to *visible* entities which satisifed the NP property at topic time.

(30) DISTRIBUTION OF NP-KA
  entities x that are in the topic context and NP(x)=1 at topic time

Comparing the generalizations in (29) and (30), we observe that the range of meanings NP-KA is associated with is a proper subset of the range of meanings NP-KII is associated with. Consequently, we propose that a competition based account between the two definite determiners can capture the -KA and -KII contrasts discussed in this paper.

5.2. Proposal

The contrasts observed in the Somali nominal TAM data can be explained by a competition based account, where the change of state and invisibility readings associated with -KII are derived from scalar implicatures.[11] The first component of our proposal is Altshuler and Schwarzschild's (2013) analysis of past stative sentences like the ones below.

(31) a. We love this puzzle.
  b. We loved this puzzle.

The core observation regarding (31) is that (31b) gives rise to the (cancellable) cessation implicature that the group denoted by 'we' no longer loves the puzzle. Example (31a), on the other hand, does not give rise to a comparable inference. Altshuler and Schwarzschild (2013) argue that the cessation implicature in a stative English past tense sentence like (31b) can be derived by setting up a competition between the *past* tense and the *present* tense. This competition is

[11] A similar account is found in Thomas (2014) for Mbyá Guaraní, where the morpheme *-kue* does not semantically encode *change of state* or *existence*, as described by Tonhauser for Paraguayan Guaraní. Thomas argues that the *cessation* inference triggered by *-kue* is a scalar implicature. The existence inference is derived from the interaction between this implicature and general interpretive properties of noun phrases. His account relies on the use of the exhaustivity operator (Fox, 2007), which, depending on the meaning of the alternatives of the proposition, following Magri (2009), negates the *contextually relevant* alternatives of the given proposition.

based on the assumption that a stative sentence in the present asymmetrically entails its past tense counterpart. Gricean pragmatic reasoning then derives the result that uttering the latter, e.g., (31b), gives rise to the inference that the former, e.g., (31a), is false.

The rationale behind this entailment pattern is this. If (31a) is true *now*, that is, if the puzzle is loved now, the puzzle was also loved a moment ago. The hypothesis that a stative in the present tense asymmetrically entails a stative in the past tense, labeled by Cable (2017) as the *Open Interval Hypothesis*, is formalized in (32).

(32) OPEN INTERVAL HYPOTHESIS: The run-time of a state is an open interval.
If s is a state and t is a temporal instant contained within the runtime $\tau(s)$ of s ($t \subseteq \tau(s)$), then $\exists t'$ such that $t' < t$ and t' is also contained within τ(s) (t' $\subseteq \tau$(s)).

In other words, if a tenseless stative clause is true at a moment m, it is also true at a moment that precedes m. Consequently, a present stative sentence entails both that the proposition is true at the time of utterance (by the contribution of present tense), and that it was true at some moment before utterance time (by the contribution of (32)). A past stative sentence, however, does not entail its present tense counterpart. This asymmetric entailment relation ensures that the use of a stative sentence in the past tense will give rise to the scalar implicature that its present tense counterpart is false. This, of course, unless independent factors block the implicature.[12] This account can be extended to explain the contrasts between the use of Somali -KII and -KA, if we make the assumption that a sentence with a -KA marked nominal asymmetrically entails its counterpart with a -KII marked nominal. (That is, if we assume that the former determiner patterns like the present tense, and the latter, like the past tense.) Hence, we propose that the difference between -KII and -KA resides in a temporal presupposition encoded by -KII.

Our analysis assumes that NPs are of type $< e, it >$. They denote functions from entities, to functions from times to truth values. We also extend the Open Interval Hypothesis in (32) to NP properties. The temporal interval t_{NP}, the time at which the NP is evaluated (Tonhauser, 2007; Thomas, 2014) and represented in (33a), picks out topic time. Examples (33a) and (33b) recapitulate the structural assumptions for Somali DPs and the denotation of NPs. The lexical entries in (33c) and (33d) give our proposed denotations for the determiners -KA and -KII, both functions from NP denotations ($< e, it >$) to functions from times to generalized quantifiers.

(33) a. $[\,[\text{ NP D}^0\,]\ t_{NP}\,]_{DP}$ where D^0 is -KII or -KA
b. $[\![\text{NP}]\!] = \lambda x_e \lambda t_i . P(t)(x)$
c. $[\![\text{KA}]\!]^{w,t,g} = \lambda P_{<e,it>} \lambda t_i \lambda Q_{<e,t>} : \exists ! x[x \in C \& P(t)(x)].Q(\iota x[P(t)(x)])$
d. $[\![\text{KII}]\!]^{w,t,g} = \lambda P_{<e,it>} \lambda t_i \lambda Q_{<e,t>} : \exists t' \exists ! x[t' < t \& x \in C \& P(t')(x)].$
$\exists t'[t' < t \& Q(\iota x[P(t')(x)])]$

[12]In Altshuler and Schwarzschild (2013) and Cable (2017) the cessation implicature arises only in the absence of a *salient past topic time*.

(i) a. We love this puzzle.
b. We loved this puzzle (yesterday).
c. We loved this puzzle as soon as we started working on it.

A cessation implicature is generated in (ib), but not in (ic). We predict the same to be true in Somali.

According to the semantics in (33c) and (33d), both -KA and -KII introduce the familiar definiteness presupposition, that there is a unique x in the context such that the property denoted by the NP holds of x. For -KA, the property must hold at topic time. The determiner -KII, on the other hand, encodes the 'precedence property,' that there is a time t' (strictly) prior to topic time such that the property denoted by the NP holds of x at t'. Applying the *Open Interval Hypothesis*, if a proposition containing a -KA marked nominal is true at topic time, then it must also have been true at some interval preceding topic time. The fact that a proposition with a -KII marked nominal holds at topic time does not entail that its -KA marked counterpart holds at topic time. Consequently, a sentence with a -KA marked nominal asymmetrically entails its counterpart with a -KII marked one.

We propose that the cessation implicature which arises in (24b), repeated below, is derived as in (34). We predict that this reasoning can be applied to any non-permanent property (event nominals, nouns denoting temporally bounded social functions like *president* or *student*).

(24) a. Bandhig-**ga** ma=ad daawatay?
exhibition-**KA** Q=2S see.2S.PAST
'Have you seen the exhibition?' $\rightarrow$ **open at UT**

b. Bandhig-**gii** ma=ad daawatay?
exhibition-**KII** Q=2S see.2S.PAST
'Have you seen the exhibition?' $\rightsquigarrow$ **closed at UT** [09/27/2015]

The pragmatic reasoning is based on computing the minimally different alternatives of a given sentence. In this case, the -KA sentence is a minimally different alternative of the -KII sentence. Given that, according to the hypothesis in (32), (24a) asymmetrically entails (24b), asserting the weaker alternative (24b) triggers the implicature that the stronger (24a) is false.

(34) PRAGMATIC REASONING FOR (24B): CESSATION IMPLICATURE

a. The speaker asserts (24b).
b. The utterances in (24a) and (24b) are identical with the exception of the D^0 node.
c. exhibition-KA corresponds to the unique x which is an exhibition in context C at UT.
d. exhibition-KII corresponds to the unique x which *was* an exhibition in context C at a time t', prior to UT.
e. The utterance in (24a) is stronger than (24b); (24a) entails (24b) according to the *Open Interval Hypothesis*. If x is an exhibition at UT, it must have also been an exhibition at some point in time **before** UT.
f. If the speaker uttered (24b), then the stronger alternative with -KA, that x is an exhibition at UT, is false.
g. Therfore, x is *not* an exhibition at UT.
h. *World knowledge*: for x to stop being an exhibition, the exhibition must have closed.

We argue that the *(in)visibility* contrast is also a derivable scalar implicature. The example in (35) is repeated from (27), where the use of -KII implies that the sun is eclipsed. We predict that the same reasoning can be applied to any noun which expresses a permanent property.[13]

[13]Our attempts to obtain data regarding invisible non-permanent properties have been unsuccessful.

(35) a. Shalay waxa=an firinayay cadcee-**da**
yesterday FOC=1S look.PAST sun-KA
'Yesterday I looked at the sun' $\rightarrow$ **visible**
b. Shalay waxa=an firinayay cadcee-**dii**
yesterday FOC=1S look.PAST sun-KII
'Yesterday I looked at the sun' $\rightsquigarrow$ **eclipsed** [01/30/2016]

Once again, minimally different alternatives are computed. Based on the hypothesis in (32), (35a) asymmetrically entails (35b), and the use of the weaker alternative implicates that the stronger alternative is false.

(36) PRAGMATIC REASONING FOR (35B): INVISIBILITY IMPLICATURE
a. The speaker asserts (35b).
b. The utterances in (35a) and (35b) are identical with the exception of the D^0 node.
c. sun-KA corresponds to the unique *x* which is a sun in context C at topic time.
d. sun-KII corresponds to the unique *x* which *was* a sun in context C at a time t', prior to topic time.
e. The utterance in (35a) is stronger than the utterance in (35b); (35a) entails (35b) according to the *Open Interval Hypothesis*. If *x* is a sun at topic time, it must have also been a sun at some point in time **before** topic time.
f. If the speaker uttered (35b), then the stronger alternative with -KA, that *x* is a sun at topic time, is false.
g. Therefore, *x* is *not* a sun at topic time.
h. *World knowledge*: the sun is permanent and unique, hence, *x* cannot stop being a sun.
i. *x* is not a sun at *topic time* in C, but *x* is always a sun.
j. The sun is invisible at topic time.

6. Concluding remarks

This paper advances the understanding of the semantics of Somali definite determiners -KA and -KII, and compares them to nominal temporal markers crosslinguistically. The comparison between Somali and Guaraní led to the conclusion that the Somali remote definite determiner -KII does not encode the *change of state* or the *existence* properties attested in Guaraní NTMs (Tonhauser, 2007). Our data point in the direction of a *temporal contrast* between the two definite determiners in Somali, and support the conclusion that the *change of state* and *invisibility* readings are, in fact, cancellable implicatures. We proposed that this contrast is semantically encoded by means of an extra temporal presupposition in the case of -KII. Assuming our proposed semantics and the *Open Interval Hypothesis* (Altshuler and Schwarzschild, 2013; Cable, 2017), -KA asymmetrically entails -KII. Under this analysis, the competition between minimally different alternatives is responsible for generating the desired implicatures.

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On the lexical semantics of property concept nouns in Basaá[1]

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Abstract. This paper considers the link between lexical category and lexical semantics, examining variation in the category of property concept (PC) words (Dixon, 1982; Thompson, 1989)—words introducing the descriptive content in translational equivalents of sentences whose main predicate is an adjective in languages with large open classes of them. Francez and Koontz-Garboden (2015) conjecture that nominal PC words might only have mass-type denotation (conceived in the spirit of Link 1983), as diagnosed by possession in predication (e.g., *Kim has beauty/#Kim is beauty*). In Basaá, a class of PC nominals we call *substance nouns* trigger possession in predication, while a class we call *adjectival nouns* do not, thereby falsifying Francez and Koontz-Garboden's conjecture. We offer several diagnostics that confirm the substance denotation for the substance nouns, and an individual-characterizing denotation for the adjectival nouns, speculating on whether such nouns have a degree semantics, and whether they represent a crosslinguistically rare category or not.

Keywords: lexical categories; semantic variation; adjectives; property concepts; mass nouns

1. Introduction: The meaning of lexical categories

The nature of the major lexical categories is among the most foundational yet poorly understood areas of grammar (Baker and Croft, 2017). Among the outstanding questions is whether there might be a link between lexical categories, which play a clear role in syntax and morphology, and the kind of meaning a word has. Although this is a question of longstanding interest, it is rarely discussed in the model-theoretic literature, save for the occasional suggestion that there might be something to say (see e.g., Bach et al. 1995; von Fintel and Matthewson 2008: 152–153; Kaufman 2009: 32; Koch and Matthewson 2009: 129). This paper is a modest contribution toward development of a program of study in this area. We focus our attention on what Francez and Koontz-Garboden (2015, 2017) call property concept sentences—sentences like (1) whose main predicate is an adjective or, as with (2), whose main predicate is not an adjective but is translated by a sentence whose main predicate *is* an adjective in languages like English.

(1) Your hair is long.

(2) *'Oku loloa ho 'ulu.*
IMP long your hair
'Your hair is long.' (Tongan; Koontz-Garboden 2007: 117)

We call the word in property concept sentences responsible for introducing the descriptive content (*long* in (1), *loloa* in (2)) the property concept (PC) word. Thanks to Dixon's (1982;

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2004) work, it is now widely known that property concept words vary in lexical category (both internal to and across languages). In (1), for example, *long* is an adjective, while *loloa* in (2) is a verb (see Koontz-Garboden 2007).

Property concept words also vary in their lexical semantics. Our focus is on a two-way distinction based on behavior in predication pointed to by Francez and Koontz-Garboden (2015). They observe that there are PC words that require possessive morphosyntax in predication (possessive-predicating PC words) and those that do not (non-possessive predicating PC words), as illustrated for Spanish in (3) and (4) respectively.

(3) *Juan tiene miedo.*
Juan has fear
'Juan is scared.'

(4) *Juan es alto.*
Juan is tall
'Juan is tall.'

Following Francez and Koontz-Garboden (2015), we take this contrast as diagnostic of a difference in the kind of meaning the PC words in the two classes of construction have: (i) those like *miedo* 'fear', which characterize substances (*substance*-type meanings, following Link 1983), and (ii) those like *alto* 'tall', which characterize individuals—specifically, those individuals that *have* the substance (e.g., a contextually salient portion of height) in question.

Concomitant with the difference in meaning of the PC words in (3) and (4), reflected in the morphosyntax of predication, is a difference in lexical category. While the substance-characterizing PC word in (3) is a noun, the individual-characterizing PC word in (4) is an adjective. Cross-classifying the adjective and noun categories with this two-way semantic typology leads to the picture in (5), with two gaps.

(5) Nominal and adjectival property concept denotations

	Individual-characterizing	*Substance-characterizing*
Adjective	English, Spanish adjectives	???
Noun	???	PC nominals like *miedo* 'fear'

Francez and Koontz-Garboden (2017: Chapter 5) argue that the gap in substance-characterizing adjectives depicted in the top right corner of (5) is genuine and principled. Substance denotations are not meanings well suited to the main function of adjectives—to act as attributive modifiers. Assuming that adnominal modification selects a subset of the denotation of the modified noun, Francez and Koontz-Garboden argue that there are no nouns with meanings that substance-characterizing adjectives could non-trivially modify.

In the sample of languages that Francez and Koontz-Garboden (2015) examined, there were no languages with non-possessive predicating PC nominals, giving rise to the conjecture that the gap on the bottom left of (5) was genuine. The implication of this gap would be that nominal property concept words were *always* substance-characterizing, and never individual-characterizing. Were this conjecture true, it would have implications for the semantics of nounhood. Yet in this paper we show that in Basaá (Bantu; Cameroon), PC nouns can have both substance-characterizing and individual-characterizing denotations. The conclusion is that nominal property concept words do not uniformly have substance-characterizing denotations.

We begin with background on the semantic typology of property concept words, discussing the two kinds of meanings that these words can have. We then turn to the Basaá case study, in order to determine (i) the category of Basaá PC words, and (ii) their lexical semantics. We start by giving three arguments for the nominal categoriality of the relevant class of PC words. Drawing on a range of novel diagnostics and by contrasting these PC words with genuine substance-characterizing ones, we then show that rather than characterizing portions of substance, they instead characterize sets of individuals. We conclude with remarks on what exactly the individual-characterizing nature of the relevant class of Basaá PC nominals is, and also suggest that a comparable class of nouns exists in English. We close with discussion of the consequences of our observations for the understanding of the link between lexical category and lexical semantics.

2. Possessive-predicating PC nominals and their substance denotations

Francez and Koontz-Garboden (2015) observe that nominal property concept words entail possessive morphosyntax for their sample of languages. Although we will argue below that there is a class of PC words in Basaá that falsify this generalization, there is also a class of PC words in the language that conforms with it. We call this class of words *substance nouns* (SNs), and they include *mbɔm* 'luck'; *nguy* 'strength'; *másɔ́dá* 'luck'; *ŋɛ́m* 'courage'; *hêmlɛ* 'hope/faith'. That such words are nominal in Basaá is uncontroversial, particularly given the fact that they are lexically associated with a noun class rather than agreeing with other nouns, fail to attributively modify nominals, can be used as the arguments of verbs, and have mass noun properties.

SNs do not behave like common nouns in predicational contexts, as expected given Francez and Koontz-Garboden's (2015) observations. Predication of a normal Basaá count noun (details of which are discussed further in §3) is copular, as shown in (6).

(6) *a ye m-alêt.*
1.AGR COP 1-teacher
'He is a teacher.' (Hyman et al. 2012:8)

Unlike with normal count nouns, attribution of a SN to an individual invokes the morphosyntax of possession. That is, the same morphosyntax—the verb *gweé* 'have'—which is required to attribute the possession of some entity to another, whether inalienably (7a) or alienably (7b), is used to attribute the substance described by a SN to an individual, as shown in (8).[2]

[2]In Basaá, 'have' is morphologically complex, literally 'be-with', and has the paradigm in (i).

(i) Tense paradigm for *ɓá-nâ* 'have'

Infin	Past3	Past2	Past1	Pres	Fut1	Fut2	Fut3
ɓánâ	*ɓáná*	*ɓéena*	*bákná*	*gweé*	*ḿ!ɓáná*	*gá!ɓáná*	*aɓáná*

(7) a. *í têble íní í gwé*ꜜ*é ma-koo mánâ*
AUG 7.table DEM AGR have 4-feet four
'This table has four feet.'
b. *Kim a gweé* ꜜ*n-dáp*
Kim AGR has 9-house
'Kim has a house.'

(8) *a gweé ma-sɔ́dá*
1.AGR have 6-luck
'(S)he is lucky.'

Drawing on the mereological approach to mass terms in Link (1983), Francez and Koontz-Garboden (2015, 2017) treat the denotations of possessive-predicating PC words as related to the denotations of familiar substance mass terms such as *gold* and *sand*.[3] For example, *ŋguy* 'strength' has such a denotation, as shown in (9), where *p* is a variable over portions of abstract matter, and *strength′* describes the property which characterizes all portions of strength.

(9) $[\![\text{ŋguy}]\!] = \lambda p[\mathit{strength}'(p)]$

Evidence that SNs have a mass-type semantics is offered in §4.1.

A substance-characterizing denotation accounts for the possessive morphosyntax used with these PC nominals. Substances, as Francez and Koontz-Garboden discuss, cannot be predicated of individuals using a copula because substances are sets of abstract portions, not sets of individuals. To the extent that any meaning is generated in ordinary copular predication with substance-characterizing words, it is an odd or metaphorical one, a fact illustrated by (10).[4]

(10) a. Kim is strength. $\neq$ Kim is strong.
b. Kim has strength. $=$ Kim is strong.

Our hypothesis, following the treatment of similar examples in other languages in Francez and Koontz-Garboden (2015), is that the use of possessive morphosyntax with such PC nominals in predication is a direct reflection of their semantics. The idea is that because a substance-characterizing PC word does not characterize a set of individuals, a relation has to be introduced to relate substances to individuals in order to attribute the substance to an individual. Francez and Koontz-Garboden call the general idea that a substance can be related to an individual with the semantics of possession *substance possession*, defining it as in (11).

(11) **Substance possession**: For any individual *a* and substance *P*, *a* has *P* iff $\exists p[P(p)\ \&\ \pi(a,p)]$

In summary, the morphosyntax of possession with nominal PC terms arises due to the underlying semantics of substance possession.

[3] See Koontz-Garboden and Francez (2010) for an inferior analysis in terms of Chierchia and Turner's (1988) property theory.

[4] In fact, in Basaá there is a group of 'have'-predicating PC nominals which allows 'be'-predication, but only in emphatic contexts. We take these cases to be direct 'be'-predication of a SN, equivalent to English expressions like *Kim IS beauty (incarnate)*, where the substance is predicated directly of the subject, meaning that Kim is literally a portion of beauty.

No such possessive semantics is at play with property concept sentences showing normal predicative morphosyntax, e.g., those with adjectives. The precise semantics for the adjectival predicates in such sentences remains an open question (see e.g., Cresswell 1977; Klein 1980; von Stechow 1984; Heim 1985; Kennedy 1997; Barker 2002; Rett 2014; Menon and Pancheva 2014; Wellwood 2015; Burnett 2016, among others). For our purposes, it does not matter what the correct theory is. What matters is simply that adjectives do not denote substances. This is the case on all theories of adjectives (and is a point explicitly argued by Francez and Koontz-Garboden 2017: Chapter 5). In one way or another, the adjectival word comes to characterize a set of individuals in some context, which can enter into ordinary processes of non-verbal predication. The headline finding of this paper is that contrary to Francez and Koontz-Garboden's conjecture, nominal PC words can have a meaning of this type, whatever its precise formal details might be.[5] In order to show this, we now make the case for the nominal status of ANs, and then show that they unequivocally have individual-characterizing meanings.

3. The lexical category of Basaá ANs

The class of PC words in Basaá of primary interest, is what Hyman et al. (2013) call *nominal adjectives* and which we call here *adjectival nouns* (ANs), in view of the fact that they are nouns, following Hyman (2003).[6] ANs constitute a large and open class of PC words in Basaá, with at least 100 members. Below we demonstrate that while ANs form a class of PC words that are demonstrably nominal in lexical category, they are not substance-characterizing, but rather characterize sets of individuals, falsifying the conjecture discussed in §1. In this section we argue for their nominal status, turning to their meaning in the section that follows.

Like most Niger-Congo languages, Basaá nominals are distributed into a rich set of noun classes. Which noun class a particular noun belongs to can be determined based on the initial prefix of the noun as well as subject agreement and DP-internal concord. Members of each of these classes are provided in Table 1, drawn from Hyman (2003: 263) with some simplifications in the representation of prefixal morphology. The numerals in the left column refer to the numbering system for Bantu noun classes standard since Meinhof (1906). These numerals label each combination of number and gender a separate class. Hyman (2003) discusses the phonological and morphological traits of the prefixal morphology in detail, and also provides detailed paradigms for DP-internal concord and subject agreement. The example below illustrates both DP-internal concord and subject agreement—the verb and DP internal modifiers agree with the head noun *nuní* 'bird' in noun class.

(12) *dí-nuní dí-tân díí dí ń! tóp hémbí*
13-bird 13.five 13.those 13.SBJ sing 19.song
'Those five birds are singing a song.'

[5] It is possible, as suggested by Beck et al. (2010); Bochnak (2013, 2015) that there might be variation in the kinds of individual-characterizing meanings that there are. Quite how Basaá ANs fit into this picture is an interesting question for future research.

[6] Our ANs are not to be confused with Hyman et al.'s adjectival nouns, which correspond to our substance nouns (SNs). Terminologically speaking, our adjectival nouns are their nominal adjectives, and our substance nouns are their adjectival nouns.

Table 1: Noun classes in Basaá

Class	Singular	Plural		Singular	Plural	
1/2	*mudaá*	*ɓodaá*	'woman'	*mut*	*ɓot*	'man'
3/4	*m-pék*	*mim-pék*	'bag'	*n-tómbá*	*min-tómbá*	'sheep'
3a/6	*nyɔ*	*ma-nyɔ*	'mouth'	*wɔɔ́*	*mɔɔ́*	'hand'
5/6	*li-pan*	*ma-pan*	'forest'	*j-alá*	*m-alá*	'crab'
7/8	*tɔ́ŋ*	*bi-tɔ́ŋ*	'horn'	*y-oó*	*gw-oó*	'yam'
9/10	*pɛ́n*	*pɛ́n*	'arrow'	*ŋ-gwɔ́*	*ŋ-gwɔ́*	'dog'
9/6	*kíŋ*	*ma-kíŋ*	'neck, voice'	*n-dáp*	*man-dáp*	'house'
19/13	*hi-tám*	*di-tám*	'kidney'	*hi-nuní*	*di-nuní*	'bird'

Table 2: NAs are found in all noun classes (Hyman et al., 2013: 2)

Class	Num.	NA	Gloss	Class	Num.	NA	Gloss
1	sing.	*n-lám*	'beautiful (sg.)'	2	pl.	*ɓa-lám*	'beautiful (pl.)'
3	sing.	*n-laŋgá*	'black (sg.)'	4	pl.	*min-laŋgá*	'black (pl.)'
5	sing.	*li-múgɛ̂*	'taciturn (sg.)'	6	pl.	*ma-múgɛ̂*	'taciturn (pl.)'
7	sing.	*lɔ́ŋgɛ̂*	'good (sg.)'	8	pl.	*bi-lɔ́ŋgɛ̂*	'good (pl.)'
9	sing.	*mbóm*	'big (sg.)'	10	pl.	*mbóm*	'big (pl.)'
19	sing.	*hi-peda*	'small (sg.)'	13	pl.	*di-peda*	'small (pl.)'

In example (12), the noun *dí-nuní* 'birds' controls agreement on the numeral, demonstrative, and the verbal prefix. We take lexically determined membership in one of the noun classes in Table 1 and the ability to control agreement to be definitional criteria for nounhood in Basaá.

All earlier descriptions, including Dimmendaal (1988); Hyman (2003); Hyman et al. (2013), agree that the PCs we are calling ANs are nouns. Evidence for their nominal categorization comes from the fact that they have lexically determined inherent noun class (from Hyman et al. 2013), as described above. This is evidenced by the fact that ANs are found in all noun classes, as illustrated by Table 2. Further evidence for their nominal status comes from the fact that when they occur DP-internally, ANs subordinate the noun they modify via a connective particle, reminiscent of English *of*, and control agreement on higher adnominal modifiers (13).

(13) a. *lí-múgɛ́ ꜜlí hí-nuní líí lí ńꜜtóp hémbí*
5-quiet 5.CON 19-bird 5-that 5.SBJ sing 19.song
'That quiet bird is singing.'

b. *má-múgɛ́ ꜜmá dí-nuní máá má ńꜜtóp hémbí*
6-quiet 6.CON 13-birds 6-that 6.SBJ sing 19.song
'Those quiet birds are singing.'

The connective particle itself also agrees with the AN, as shown by Table 3; note that the connective which appears in this construction can be purely tonal, a low tone in class 1 and 9, and a high tone in class 3 and 7 (Hyman et al., 2013: ex. (10)). This is true generally of other

Table 3: Agreement of the connective with ANs

Cl	AN	of	N		Cl	AN	of	N	
1	*n-lám*		*hi-nuní*	'beautiful bird'	2	*ɓa-lám*	*ɓá*	*dí-nuní*	'beautiful birds'
3	*n-laŋgá*		*hí-nuní*	'black bird'	4	*min-laŋgá*	*mí*	*dí-nuní*	'black birds'
5	*li-múgɛ̂*	*ꜜlí*	*hí-nuní*	'quiet bird'	6	*ma-múgɛ̂*	*má*	*dí-nuní*	'quiet birds'
7	*lɔ́ŋgɛ̂*		*hí-nuní*	'good bird'	8	*bi-lɔ́ŋgɛ́*	*ꜜbí*	*dí-nuní*	'good birds'
9	*mbóm*		*hi-nuní*	'big bird'	10	*mbóm*	*í*	*dí-nuní*	'big birds'
19	*hi-peda*	*hí*	*hí-nuní*	'small bird'	13	*di-peda*	*dí*	*dí-nuní*	'small birds'

DP internal modification where the modifier is nominal, as with possessive DPs and noun-noun compounds (Hyman et al., 2013). One important point to note about the construction illustrated in Table 3 is that the AN and N always agree in number, even if they occur in different genders or noun classes.

Further evidence for the nominality of ANs comes from the existence of a separate class of true adjectival PCs (adjectives) in Basaá. Such genuine adjective is illustrated in (14), where the adjective *kɛ́ŋí* 'big' does not control agreement on the noun or subject auxiliary, but transparently reflects the noun class of the noun it modifies. Further, it modifies the head noun without a connective, unlike nominal modifiers (with AN or not), described previously.

(14) *hí-nuní hi-kɛ́ŋí híí hí ńꜜtóp hémbí*
19-bird 19-big 19-that 19.SBJ sing 19.song
'That big bird is singing.'

The number of adjectives in Basaá is relatively small, so Basaá is therefore like many languages of the world in having a closed adjective class (Hyman et al., 2013). Crucially for our purposes, we will see below that true adjectives and ANs cannot be distinguished semantically, so they are only distinguished by their syntactic category, revealed in their morphosyntactic behavior.

4. The lexical semantics of Basaá ANs

Having demonstrated the nominality of ANs, we now examine their semantics. Given the discussion above, an obvious starting point is asking how they behave in predication. Here, as already mentioned, we find behavior different from that observed with nominal PCs elsewhere, both from SNs in Basaá, discussed above, and the nominal PCs from other languages discussed in Francez and Koontz-Garboden (2015).

Basaá has a copula *ɓá* which occurs as the main verb in sentences with a variety of non-verbal predicates.[7] This copula occurs with predicate nominals (15a), locatives (15b), and genuine

[7]The verb *ɓá* 'be' is characterized by extensive suppletion, as shown in (i).

(i) Tense paradigm for *ɓá* 'be'

Infin	Past3	Past2	Past1	Pres	Fut1	Fut2	Fut3
ɓá	*ɓá*	*ɓée*	*bák*	*ye*	*ḿꜜɓá*	*gáꜜɓá*	*aɓá*

adjectives (15c), along with, crucial for our purposes, ANs (15d):

(15) a. *Victor a ye m-alêt*
Victor 1.SUB be 1-teacher
'Victor is a teacher.' (predicate nominal)
b. *hí-nuní híí hí yé í kedé* ꜜ*ɛ́*
19-bird 19.that 19.SUB be LOC inside tree
'That bird is inside the tree.' (e.g. in a hole) (locative)
c. *hí-nuní híí hí yé hi-kɛ́ŋí*
19-bird 19.that 19.SUB be 19-big
'That bird is big.' (adjective)
d. *hí-nuní híí hí yé li-mugɛ̂*
19-bird 19.that 19.SUB be 5-quiet
'That bird is quiet.' (adjectival noun)

We assume that copular predication in contexts like those above is a transparent indication that the following predicate characterizes a set of ordinary individuals (cf. Partee 2002). Thus, the fact that adjectives and ANs are predicated with a copula is a transparent indication that adjectives and AN denote sets of ordinary individuals, like nominal and locative predicates. Below we present three additional arguments for this claim.

4.1. Atomicity

In this section we illustrate that ANs and SNs are distinct in terms of atomicity: while ANs have atomic denotations, and are hence count nouns, SNs have non-atomic denotations and behave like mass nouns. Mass-like denotations are expected for SN given their substance-based semantics described in §2.

The simplest evidence that ANs are count nouns while SNs are mass nouns comes from the number invariance of SNs. In §3, it was shown that ANs reflect the number of the noun they modify in the AN-of-N construction (Table 3). Thus, a distinction exists between *nláám* 'beautiful' and *ɓaláám* 'beautiful' depending on whether the noun is singular or plural in (13). By contrast, SNs do not inflect for number at all. This can be seen in both adnominal modifying and predicative environments. Beginning with attributive environments, the data in (16) demonstrate that like ANs, nominal modification with SNs requires a connective. But while ANs precede the connective, controlling agreement on higher modifiers (13), SNs follow the connective, and the modified noun controls agreement. What is crucial for our current purposes is that unlike ANs, SNs do not reflect the number of the noun which they modify. This is illustrated by (16), where the SN *ŋ́gûy* 'strength' is invariant regardless of whether it is modifying a singular or plural noun:

(16) a. *hi-nuní hí ŋgûy hí ń*ꜜ*tóp hémbí*
19-bird 19.CON 9.strength 19.SBJ sing 19.song
'The strong bird is singing'

Table 4: Substance nouns (SNs) in Basaá

Class	N	of	SN	
1	*hi-nuní*	*hí*	*máaŋgɛ́*	'baby bird' (bird of child)
3	*hi-nuní*	*hí*	*ń-saŋ*	'peaceful bird' (bird of peace)
4	*hi-nuní*	*hí*	*mí-yaó*	'likable bird' (bird of charm)
5	*hi-nuní*	*hí*	*lí-han*	'mean bird' (bird of meanness)
6	*hi-nuní*	*hí*	*má-sɔ́dá*	'lucky bird' (bird of chance)
7	*hi-nuní*	*hí*	*ságlá*	'annoying bird' (bird of annoyance)
8	*hi-nuní*	*hí*	*bí-sagda*	'unsteady bird' (bird of confusion)
9	*hi-nuní*	*hí*	*ŋgûy*	'strong bird' (bird of strength)

b. *di-nuní dí ŋgûy dí ń!tóp hémbí*
13-birds 13.CON 9.strength 13.SBJ sing 19.song
'The strong birds are singing'

Furthermore, while each lexical SN can be morphologically singular or plural, each individual SN is number-invariant, occurring in either a singular or plural noun class, as shown by the data in Table 4. Thus, the singular class 3 *ǹsaŋ* 'peace' has no class 4 plural counterpart **mísaŋ*. Likewise, the plural class 4 *míyaó* 'charm' has no singular class 3 counterpart **nyaó*. The difference between ANs and SNs in the ability to mark number is thus directly manifested in DP-internal environments: only ANs reflect the number of the noun they modify.

The number invariance of SNs also contrasts with ANs in predicational environments. Like adjectives and predicate nominals, ANs typically reflect the number of the subject:

(17) *dí-nuní díí dí yé ma-múgɛ̂*
13-bird 13.that 13.SUB be 6-quiet
'Those birds are quiet.'

The subject in (17) is plural, thereby triggering class 6 on the AN in this position.[8] In contrast, SNs do not exhibit number agreement with the subject of 'have' in predicational environments, as shown by (18).

(18) a. *a gweé *n/mi-yáo*
1.AGR have 3(SG)/4(PL)-charm
'(S)he is likable.'

b. *ɓá gwé!é *n/mi-yáo*
2.AGR have 3(SG)/4(PL)-charm
'They are likable.'

[8] Number agreement in the copular construction is not obligatory when the subject is plural. As discussed in Hyman et al. (2013), with predicates that allow collective readings, singular predicates overtly indicate a collective reading while plural predicates occur with distributive readings.

Thus, a corollary of the general number-invariance of SNs is their inability to agree with nouns in number in both attributive and predicational environments. These diagnostics we believe are tied to atomicity—the question whether there are atomic parts in the denotation of the noun, as is the case with count nouns, or not, as is the case with mass nouns (Link, 1983). Consistent with our claim that SNs are substance-characterizing, then, these facts point to a non-atomic denotation for SNs. ANs, consistent with our claim that they characterize sets of (atomic) individuals, behave in the opposite manner.

A more direct diagnostic for this distinction comes from numerals: while numerals can combine with ANs, they cannot with SNs, as shown by (19a,b) respectively.[9]

(19) a. *ma-múgɛ́ ꜜmá dí-nuní mátân*
6-quiet 6.6.CON 13-bird 6.five
'five quiet birds'

b. **miyáo (míntân) mí hí-nuní (míntân)*
4-charm (4.five) 4.CON 13-bird (4.five)
(intended: *'five charms of the bird')

In (19a), *mátân* 'five' agrees with the AN *ma-múgɛ́* 'quiet', and as such the AN must preserve or share the count-status of the head noun it modifies. In contrast, (19b) illustrates that SNs cannot combine with numerals when they serve as the head of the noun phrase. As countability is a standard diagnostic for atomicity (and thereby count versus mass status, e.g. Rothstein 2010), we take the distribution of numerals to confirm that ANs have atomic denotations (and are count nouns) while SNs have non-atomic ones (and are mass), consistent with the claim that the former have individual-characterizing denotations, while the latter denote substances.

4.2. Weak quantifiers

Additional circumstantial evidence for the individual-characterizing denotation for ANs comes from the syntactic behavior of various quantifiers in Basaá. Landman (2003) argues that while strong determiners are generalized quantifiers, i.e. interpreted as relations between sets (Montague 1973; Barwise and Cooper 1981) indefinite determiners have adjectival meanings, and are functions from nominal denotations to a subset of the nominal denotation with restricted cardinality. For example, while *birds* denotes the set of any plurality of birds, whether two or ten thousand, *several birds* denotes a much more restricted set of bird pluralities—namely those comprised of say, 3-10 atomic bird individuals. It turns out that in Basaá weak quantifiers, by contrast with strong quantifiers, pattern like ANs in several ways. This behavior, we argue, makes sense if weak quantifiers and ANs both characterize sets of individuals. The former is consistent with Landman's claims, the latter with our claim about the semantic nature of ANs.

[9] That the numeral is modifying the AN in (19a) and the SN in (19b) is shown by agreement—the numeral agrees in noun class with the AN in (19a) and the SN in (19b), as is typical for adnominal numeral modifiers in the language generally.

NP-internally, weak quantifiers in Basaá pattern just like ANs. This is demonstrated by the data in (20), which shown that such quantifiers head the NPs they determine, triggering use of a linker particle the noun class agreement of which they control.

(20) a. *ŋgandak í dínuní í yé mınlaŋgá*
3.many 3 19.birds 3.AGR be 4.black
'Many birds are black.'

b. *ndek dínuní í yé mınlaŋgá*
3.few (3)-19.birds 3.AGR be 4.black
'Few birds are black.'

c. *joga lí dínuní lí yé mınlaŋgá*
5.several 5 19.birds 5.AGR be 4.black
'Several birds are black.'

d. *pɛs í dínuní í yé mınlaŋgá*
3.half 3 19.birds 3.AGR be 4.black
'Half the birds are black.'

Unlike weak quantifiers, strong quantifiers do not pattern as ANs. The actual behavior of strong quantifiers is heterogeneous, as evidenced by the data in (21), where *hígií* 'every' appears prenominally and *cɔ́dísó* 'all' appears postnominally.

(21) a. *hígií hinuní hí yé nlaŋgá*
19.every 19.bird 19.AGR be 3.black
'Every bird is black.'

b. *dínuní cɔ́dísó ꜜdí yé mınlaŋgá*
AUG-13.birds all 13.AGR be 4.black
'All birds are black.'

In both cases, however, the quantifiers behave differently from the weak quantifiers in (20), in that neither of them heads the NP they determine or controls agreement. This is shown in (21a) by the lack of a linker particle and by the fact that *hígií* 'every' agrees with the head noun 'bird'. The quantifier *cɔ́dísô* 'all' in (21b) simply does not agree, nor is there any question of it being in head position, as it is postnominal. This contrast in the behavior of weak and strong quantifiers makes sense if weak quantifiers and ANs are in the same semantic class (at some level), and if this class is individual-characterizing (as Landman independently argues for most weak quantifiers), the idea being that the head noun (whether AN or weak quantifier) composes with the post-linker noun through some form of predicate modification (as argued for weak quantifiers by Landman 2003: 2).

We have already seen that ANs are copular-predicating, as expected for words that characterize sets of individuals. The same is expected of weak quantifiers on Landman's theory. This prediction is borne out, as shown by (22).[10]

[10]There are two exceptions to this, *ŋgim* 'some' and *tɔ* 'no'. In the case of quantifiers like the latter, Landman (2003: 12) argues for a special treatment on independent grounds. An explanation for the behavior of Basaá *ŋgim* 'some' requires further investigation.

(22) a. *dínuní tíní dí yé ŋgandak*
birds these AGR be a.lot
'These birds are many.'
b. *dínuní tíní dí yé ndek*
birds these AGR be few
'These birds are few.'
c. *dínuní tíní dí yé joga*
birds these AGR be several
'These birds are several.'
d. *dínuní tíní dí yé pɛs*
birds these AGR be half
'These birds are half.'

Further, as expected if strong quantifiers are not individual characterizing, but rather have some other kind of non-predicative denotation (for example relations between sets, as Landman argues), then we expect strong quantifiers to be unacceptable in predicative environments, unlike weak quantifiers. This contrast is borne out, as evidenced by the data in (23).

(23) a. **dínuní tíní dí yé hígií*
birds these AGR be every
*'These birds are every.'
b. **dínuní tíní dí yé cɔ́dísô*
birds these AGR be all
*'These birds are all.'

To reiterate, the basic observation is that weak quantifiers and ANs pattern together in some key ways. This behavior makes sense if they have the same kind of denotation, and if that denotation is an individual-characterizing one, as Landman argues for weak quantifiers on independent grounds, and as other diagnostics in this paper independently point to for ANs.

4.3. Pronominal anaphora

A final argument for our claim that ANs characterize individuals comes from pronominal anaphora. The observation is simply that there is a predicate anaphor in Basaá that is restricted in the types of predicates it can be anaphoric to. Specifically, the particle in question is *wɛɛ́*, and it can be anaphoric to SNs (24), but not to ANs (25), adjectives (26), or common nouns (27).

(24) *líhat, wɛɛ́ Paul*
rich WEE Paul
'Rich, that's Paul.'

(25) *#nlám, wɛɛ́ Paul*
pretty WEE Paul
'Pretty, that's Paul.'

(26) *#ŋkɛ́ŋí, wɛɛ́ Paul*
important WEE Paul
'Important, that's Paul.'

(27) *#malêt wɛɛ́ Paul.*
teacher WEE Paul
'Teacher, that's Paul.'

This behavior makes sense if *wɛɛ́* is a sortally-sensitive anaphor, which can refer back to substance-characterizing denotations but not individual-characterizing ones.[11] The key fact for the purposes of the discussion here is that ANs cannot be the antecedent of *wɛɛ́*, by contrast with SNs, consistent with the former's lacking a substance-characterizing denotation and the latter's having such a denotation.

5. Some questions

The facts discussed above demonstrate that ANs do not have a substance-characterizing denotation, and have generally concluded that they are individual-characterizing. What they don't answer are (i) what precise denotation ANs have, and (ii) whether Basaá is genuinely special in having property concept nominals with this kind of denotation.

Beginning with the first question, the meaning of Basaá ANs is a difficult one because there is a fair amount of controversy about what exactly the denotation of adjectives is, with some researchers additionally claiming that adjectival meanings differ across languages (Beck et al., 2010; Bochnak, 2013; Bowler, 2016)). Three types of theory of adjective denotation are laid out in (28):

(28) Three theories of adjectives
  a. Adjectives denote contextually sensitive sets of individuals (e.g., Kamp 1975; Klein 1980; van Rooij 2011).
  b. Adjectives denote relations between individuals and a degree argument, with the degree to which the adjective holds specified either morphosyntactically or in context (e.g., Cresswell 1977; von Stechow 1984; Kennedy 1999).
  c. Adjectives denote what *have* + substance nouns denote (see Menon and Pancheva 2014).

If Bochnak's (2013; 2015) analysis and diagnostics are taken at face-value, we can exclude (28a) from consideration for Basaá ANs, on the grounds that ANs behave like they have a degree (or alternatively, portion) argument—they can be used with measure phrases (29a) and in explicit comparatives (29b), for example.

(29) a. *ŋ-koo ú yé n-tendéé méda mí-tân*
  3-rope AGR be 4-long 4.meter 4-five
  'The rope is five meters long.'
 b. *hí.ní hi-nuní hi yé hi-láám lɛ̂l hí-í.*
  19-this 19-bird 19.AGR is 19-nice surpass 19-that.one
  'This bird is nicer than that one.'

[11]The proposed contrast is similar in spirit (if different in details) to the ability of *it* and *that* in English to have predicative (but not individual-denoting) antecedents, as discussed e.g., by Mikkelsen (2005), and shown by the data in (i).

(i) a. The tallest girl in the class, that/it's Molly.
 b. The tallest girl in the class, she/*it/*that's Swedish. (Mikkelsen, 2005: 64)

The same points could be made for true adjectives in Basaá, illustrating more clearly that ANs and adjectives are semantically similar.

In addition, Bassaá has a gradable modifier that can be used with ANs, *ŋgandak*:[12]

(30) *di-nuní dí yé min-laŋgá ŋgandak.*
13-birds 13.AGR COP 4-black very
'The birds are very black.'

While the same modifier can be used with adjectives (31), it can also be used SNs (32), a fact which might suggest that ANs and the *have+SN* constituent should have the same type of denotation in order to give a uniform denotation to *ŋgandak*.

(31) *hí-nuní híí hí yé hi-kɛ́ŋí ŋgandak.*
19-bird 19.that 19.SUB be 19-big very
'That bird is big.' (adjective)

(32) *kim a gweé ŋguy ŋgandak*
kim AGR has strength very
'Kim is very strong.' (SN)

Nevertheless, it is still an open question whether this denotation is one that invokes degrees (and scales) or portions (and substances). To a large degree, this is a conceptual issue, though Francez and Koontz-Garboden (2015: 552–556) point to some empirical considerations which could possibly distinguish between the two kinds of theories. The issue hinges largely on the nature of the ordering relation on the degrees/portions, and whether it is antisymmetric (as it is on degree-based theories) or not (as in Francez and Koontz-Garboden's portion-based theory). Further work is needed to examine this issue in Basaá and more generally.

The discussion thus far has been aimed simply at establishing the existence of individual-characterizing property concept nominals, and has used Basaá for the purposes of an unambiguous existence proof. We have not explored whether Basaá is unique in having property concept nominals of this type, however. As it happens, there is a case that English in fact has property concept nominals similar to Basaá ANs, even if these might be less numerous. The issue hinges on whether nouns like those in (33) are property concept nominals or not. While some of these are restricted to human nouns (*savant, genius*) or to inanimate nouns (*antique*), others are less restricted (e.g., *giant*), much like adjectives that could be used to paraphrase them (e.g., *huge*), suggesting that these should be classed as property concept words.[13]

(33) idiot, savant, genius, giant, antique, disaster

[12]We have not investigated closely whether this gradable modifier shows all the requisite properties of a genuine degree/portion modifier; see Beltrama and Bochnak 2015 for discussion.

[13]These considerations point to the inductive nature of the notion of *property concept word*, and to the need for a property theory of what actually characterizes this class. This issue is one in need of work, and would answer the main question of Dixon (1982): why do adjectives have the meanings they have, particularly in languages with small closed classes of them, where such meanings are predictable?

This class of nouns use copular morphosyntax in predication, rather than possession.

(34) a. This election is a disaster.
b. #This election has disaster.

Nouns like *idiot* and *disaster* have, in fact, been investigated in some detail by Morzycki (2012), who points out that there are gradable modifiers in English that can be used with just nouns like these (but not, for example, nouns like *resident, teacher*, etc.), a fact which coupled with their behavior in predication, again makes them look like the Basaá ANs:

(35) a. an utter/huge/big disaster/idiot/genius
b. #an utter/huge/big teacher/table

In addition, these nouns can modify other nouns in a construction which closely resembles the Basaá AN-of-N construction (see Alexiadou et al., 2007: ch. 2 for an overview):

(36) a. that idiot of a doctor
b. the disaster of an election

We can make sense of such facts if these nouns have a denotation like adjectives (a relation between degrees and individuals, or alternatively portions of substance and individuals), with the degree argument saturated by a degree modifier, as in (35), or by *Pos*, creating a predicate of individuals. This suggests that Basaá might be special not so much in having individual-characterizing nominal property concept words, but rather having such a large, open, and productive inventory of them alongside the absence of a large open class of adjectives (cf. English).

6. Concluding remarks: Nominally encoded PCs have an argument in domain of substance

It is widely known by now, thanks to Dixon's (1982, 2004) observations, that property concept words can be nominal, adjectival, and verbal. More recently, Francez and Koontz-Garboden have shown that they also vary in their denotation—while property concept words in the familiar, best explored cases involving adjectives are individual-characterizing, there are many, particularly involving nouns, which are substance-characterizing. The program that the work in this paper fits into is that of determining whether all possible cross-classifications of category and meaning are attested, with the goal of using such a cross-classification to better understand the ways in which lexical categoryhood constrains word meaning. Limiting ourselves to adjectives and nouns, cross-classifying category with the two kinds of denotation identified by Francez and Koontz-Garboden leads to a picture like that in (37).

(37) Nominal and adjectival property concept denotations

	Individual-characterizing	*Substance-characterizing*
Adjective	English, Basaá adjectives	∅
Noun	**Basaá ANs**	Basaá SNs

The aim of the program is to determine whether the empty cells are genuinely empty, and if so why. In the case of substance-characterizing adjectives, for example, Francez and Koontz-Garboden (2017: Chapter 6) argue that they are genuinely unattested, and that their absence (impossibility, they argue) follows from the very nature of the adjectival category itself. In this way, the program leads to a better understanding of the nature of lexical categoryhood, adjectives in particular.

The question we have explored in this paper is whether the lower-left hand corner of the table in (37) is attested or not, i.e., whether there exist individual-characterizing property concept nouns. Previously, all known nominal property concepts have had substance-characterizing denotations, leading to the conjecture that they always had this denotation. We have shown that so-called Basaá adjectival nouns are at once nominal and individual-characterizing. Outstanding is still the question of precisely how Basaá adjectival nouns characterize individuals. As discussed briefly in §2, there is much debate in the formal literature about what precisely the denotation of adjectives are. The questions raised in that literature are relevant for the consideration of the precise denotation for Basaá adjectival nouns, and more work is needed. Further, it may well be that what is right for adjectives is actually not right for Basaá adjectival nouns, raising again the question of variation in denotation, and whether that might be tied to lexical category, albeit in a different form, with different kinds of denotations under consideration. In this paper, we have limited ourselves to the question of substance-characterizing denotations versus individual-characterizing denotations, without considering in a precise fashion what the latter are. Future work on Basaá should consider in a more precise fashion than we have done here what the denotations of Basaá adjectival nouns are, and what the observations made about these denotations tells us about the interface between lexical semantics and lexical category. For now, it is at least clear that property concept nominals need not be substance-characterizing.

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Stativity and progressive: The case of Japanese '*tokoro-da*'[1]

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Abstract. The Japanese noun '*tokoro*' (lit. 'place') has a grammaticalized variant with a temporal interpretation (Takubo 2011). Syntactically, this variant behaves like a noun and is typically modified by a sentence (or a suitable proform). The resulting NP '*S-tokoro*' roughly means 'time at which S'. With the copula '*da/datta*' (Nonpast/Past) it can form a matrix sentence; but on its own it can also be used as a temporal adverbial. In these respects it is similar to other temporal expressions like '*S-mae*' ('time before S'), '*S-ato*' ('time after S), and '*S-toki*' ('time at which S'). But the acceptability and interpretation of '*S-tokoro*' interacts with the temporal and aspectual properties of '*S*' in puzzling ways. Focusing on matrix uses in this paper (embedded ones being similar), we develop an analysis that accounts for those interactions.

Keywords: tense, aspect, temporal adverbs, modality, counterfactuality, progressive, Japanese

1. Introduction

The Japanese noun '*tokoro*' (lit. 'place') has a grammaticalized variant as a "formal noun" (形式名詞), a dependent category taking a sentential complement to form a compound which behaves outwardly like a noun phrase. In this paper we focus on sentences formed of such an '*S-tokoro*' phrase and a tensed form of the copula '*da*', shown schematically in (1).[2]

(1) [[SENTENCE] tokoro] { da / datta }

Here SENTENCE stands for a tensed clause and '*da, datta*' are the Nonpast and Past forms of the copula. On the temporal interpretation of '*tokoro*' (other readings are possible, see below), (1) locates the matrix reference time relative to a time at which SENTENCE is or was true. The temporal and aspectual properties of SENTENCE play a crucial role in determining both whether the construction as a whole is well-formed, and if it is, how it is interpreted. Our goal in this paper is to give a semantic analysis which accounts for these interactions. The observation we are most interested in is that only non-stative and progressive SENTENCES are allowed under temporal '*tokoro*', whereas lexical statives and perfects are not.

[1]This paper is part of an extensive ongoing project with Yukinori Takubo, to whom we are grateful for much inspiration and discussion. However, the analysis presented here is our own and differs from his in important respects. We are also grateful to Setsuko Arita, Ikumi Imani, Yuya Okawa, Yukiko Atarashiya, the audiences the workshop on *Modality as a window on cognition* (19th International Congress of Linguistics, Geneva, 2013), the Meikai University Linguistics Colloquium (2015), Sinn und Bedeutung 21 (Edinburgh, 2016), and the Meaning Group at the University of Connecticut (2016), for comments and discussion. Part of this work was carried out during a semester at Kyoto University in Fall, 2015. We are grateful to Yukinori Takubo, the Japan Society for the Promotion of Science (Grant L-15504), and Kyoto University for their hospitality and support.

[2]'*S-tokoro*' can also occur in other environments, but its interpretation in such contexts does not differ significantly from that in (1), so we focus on the latter for the purposes of this paper.

1.1. Temporal '*tokoro*' with non-statives

Our analysis of the tenses follows Kaufmann and Miyachi (2011; henceforth KM11). Sentences denote binary relations between temporal intervals, i.e., sets of pairs $\langle i, j\rangle$. In a non-stative like (2a), the relation holds if and only if (i) j is the temporal trace of an event of Jon putting on a red jacket; and (ii) either $i < j$ (for Nonpast) or $j < i$ (for Past). In Reichenbachian terms, in matrix contexts i and j correspond to speech and reference time, respectively.

(2) a. Zyon-ga akai zyaketto-wo { ki-ru / ki-ta }
Jon-NOM red jacket-ACC put on-NONPAST put on-PAST
'Jon { will put on / put on } a red jacket'
b. [Zyon-ga akai zyaketto-wo ki-ru] tokoro { da / datta }
'Jon { is / was } just about to put on a red jacket'
c. [Zyon-ga akai zyaketto-wo ki-ta] tokoro { da / datta }
'Jon { has / had } just put on a red jacket'

In (2b), the Nonpast version of (2a) is embedded under '*tokoro*' and the tensed copula. We aim to give (2a) a uniform analysis for matrix and embedded contexts, thus we assume that, as in (2a), the embedded clause '*Zyon-ga akai zyaketto-wo ki-ru*' denotes a binary relation between intervals $\langle i, j\rangle$. Now, however, i and j correspond to the reference times of the matrix clause and the embedded clause, respectively. Thus for (2b) and (2c) to be true, the matrix reference time must **precede** and **follow** that of the embedded clause, respectively. In both of (2b,c), the relation between the speech time and the matrix reference time is constrained by the tense on the copula. The presence of '*tokoro da/datta*' means that (2b,c) are stative (in contrast to the non-stative (2a)). In this case, a co-temporal reading is available for Nonpast '*datta*' under which speech and reference time coincide.

Thus (2b,c) basically assert that the reference time is/was **before** or **after** the dressing event, respectively. One may wonder how they differ from their counterparts with '*mae*' and '*ato*', the more canonical Japanese counterparts of '*before*' and '*after*'. We discuss this relationship in some detail below. For now, suffice it to say that (2b,c) are indeed close in meaning to their counterparts in (3a,b), with the important difference that (2b,c) carry a connotation of **immediacy**, expressed in (2) in our gloss using English '*just*', which (3a,b) lack.

(3) a. [Zyon-ga akai zyaketto-wo ki-ru] { mae / *ato } { da / datta }
'Jon { is / was } just about to put on a red jacket'
b. [Zyon-ga akai zyaketto-wo ki-ta] { *mae / ato } { da / datta }
'Jon { has / had } just put on a red jacket'

1.2. Temporal '*tokoro*' with lexical statives

Stative clauses also denote binary relations between intervals but there are differences in detail which lead to markedly different patterns in well-formedness and interpretion under '*tokoro*'.

In matrix-level statives, the interpretation is similar to that of non-statives, except that Nonpast allows for speech and reference time to coincide. Thus in terms of the relationship between i, j, we have $j < i$ for Past (as with non-statives) and $i \leq j$ for Nonpast (cf. $i < j$ for non-statives). In embedded contexts, however, i must be contained in j; as a consequence, Past tense is disallowed (hence the ill-formedness of (4c)) and Nonpast lacks the futurate interpretation on which $i < j$. These facts are shared across a range of embedding contexts (see KM11 for data and discussion), but '*tokoro*' adds even more constraints: the embedded Nonpast in (4b) is also peculiar. Most informants judge it to be marginal and, if acceptable at all, restricted to the **counterfactual** reading indicated in the gloss.

(4) a. Ie-ni { i-ru / i-ta }
home-LOC be-NONPAST be-PAST
'I { {am/will be} / was } at home.'
b. ?[Ie-ni i-ru] tokoro { da / datta }
'I would { be / have been } at home.'
c. *Ie-ni i-ta tokoro { da / datta }

In this paper we aim to explain the absence of a temporal reading for (4b). We leave the analysis of the counterfactual reading for another occasion.

1.3. Temporal '*tokoro*' with derived statives

In addition to lexical statives, Japanese has aspectual operators which form **derived statives** from eventive complements. A well-studied expression of this kind is the suffix '*-tei-*', which combines with the stems of non-stative verbs[3,4] and can have either **progressive** or **perfect** readings, depending on the aspectual properties of the complement and contextual factors. This is illustrated by (5b), which has the two readings indicated in the translation.

(5) a. Zyon-ga akai zyaketto-wo { ki-tei-ru / ki-tei-ta }
Jon-NOM red jacket-ACC wear-TEI-NONPAST wear-TEI-PAST
Progressive: 'Jon { is / was } putting on a red jacket'
Perfect: 'Jon { is / was } wearing a red jacket'
b. [Zyon-ga akai zyaketto-wo ki-tei-ru] tokoro { da / datta }
Progressive: 'Jon { is / was } putting on a red jacket'
Perfect: 'Jon would { be / have been } wearing a red jacket'
c. *[Zyon-ga akai zyaketto-wo ki-tei-ta] tokoro { da / datta }

That one morpheme should have these two seemingly incompatible uses is puzzling and has made '*-tei-*' one of the most written-about expressions in the Japanese linguistic literature. We postpone further discussion to the analysis below. For now, we only point out that the sentences derived with '*-tei-*' exhibit an intriguing behavior when combined with '*tokoro*', as

[3] Certain other derivational morphemes can intervene between the verb stem and '*-tei-*', for instance Passive, Causative and Potentialis, but not Negation. The details are not relevant here.

[4] The claim that '*-tei-*' combines only with non-statives is widely accepted in the literature. Incompatibility with '*-tei-*' is Kindaichi's (1950; 1976) main diagnostic for the class of stative verbs in his taxonomy (jôtaidôsi).

shown in (5b): On the Progressive reading of '-*tei*-', '*tokoro*' adds a purely temporal interpretation meaning 'while/when', even though no such interpretation is available either with lexical statives, which force a counterfactual reading in this case (cf. (4b)), or with eventives, on which the temporal interpretation would be 'before' (cf. (2b)). On the Perfect reading of '-*tei*-', the sentence patterns with lexical statives in that only a counterfactual reading is available. Notice also that (5c) patterns with stative (4c) and not with eventive (2c) in that the string is ill-formed.

This is the main puzzle to be addressed in this paper: On the one hand, Progressive and Perfect are generally considered derived statives, and the Japanese examples exhibit some properties that are expected under this analysis (e.g., the ill-formedness of (5c) and the relationship between the matrix and embedded reference times in (5b)). On the other hand, under '*tokoro*' the Perfect is restricted to a counterfactual reading like other statives, while the Progressive has a temporal reading – which, however, is unlike that obtained with non-statives.

2. Theoretical background

We develop our analysis in a slightly simplified version of the framework introduced by KM11.[5] The major ingredients are shown in (6) along with their hierarchical structure in the sentence.

(6) [[[[SENTENCE RADICAL] ASPECT] TENSE] ENVIRONMENT]

Sentence radicals come in two major classes, stative and non-stative. We are not concerned here with the kind of sub-sentential aspectual composition that arises with quantification and distributivity, for instance, but we do need a formal representation of the stative/non-stative distinction. Aspectual operators impose temporal constraints on reference times and relate events to times. We assume that '-*tei*-' is such an operator. But even sentences without '-*tei*-' or other overt aspectual markers include a covert aspectual operator. In this we follow KM11. There are two tenses, Nonpast and Past, whose interpretation depends on the aspectual class of their complement as well as on the difference between matrix and embedded contexts. What we label as "Environment" in (6) is either the matrix context or one of a class of subordinating expressions which includes '*tokoro*'.

2.1. The model

Let $\langle T, \prec \rangle$ be a non-empty set of temporal instants ordered by the transitive, irreflexive and connected relation $\prec$. The **temporal period structure** induced by $\langle T, \prec \rangle$ is a triple $\langle I, \subseteq, < \rangle$, where I is the set of non-empty convex subsets of T,[6] $\subseteq$ is set-theoretic inclusion, and $<$ is the relation of strict precedence on $I \times I$. An **event structure** is a join-semilattice $\langle E, \sqsubseteq \rangle$, where E is a non-empty set of events and $\sqsubseteq$ is a partial order interpreted as the mereological "sub-event" relation. A **temporal model** is an octuple $\langle I, \subseteq, <, E, \sqsubseteq, \tau, s, V \rangle$, where $\langle I, \subseteq, < \rangle$ is a temporal period structure; $\langle E, \sqsubseteq \rangle$ is an event structure; $\tau : E \mapsto I$ maps events to their temporal traces, subject to the condition that for all $e, e' \in E$, if $e \sqsubseteq e'$ then $\tau(e) \subseteq \tau(e')$; $s \in I$ is a (short)

[5] The simplification concerns KM11's account of absolute tense under '*toki*', which is orthogonal to this paper.
[6] A set $T' \subseteq T$ is **convex** iff for all t, t', t'', if $t \prec t' \prec t''$ and $t, t'' \in T'$, then $t' \in T'$.

interval representing the speech time; and V is an interpretation function mapping non-stative and stative sentence radicals to (characteristic functions of) subsets of E and I, respectively.

We present our analysis as a compositional mapping from Japanese sentences to expressions in an extensional type-theoretical language which are then to be interpreted in temporal models. The basic types are i with $D_i = I$ (intervals), ϵ with $D_\epsilon = E$ (events) and t with $D_t = \{0,1\}$ (truth values). We do not define the language or its interpretetion explicitly because both will be obvious. We do assume that it has variables $i, j, k, \ldots$ ranging over intervals and e ranging over events; and symbols for unary predicates of intervals and events (corresponding to sentence radicals). We overload the symbols $s, \tau, <, \subseteq$ (mapped to the speech time s, the temporal trace function, the precedence relation $<$, and the subinterval relation). We will define further symbols below.

2.2. Sentence radicals

Stative and non-stative sentence radicals denote properties of intervals and events, respectively.

(7) Zyon-ga Nihon-ni i-
Jon-NOM Japan-LOC be
'Jon be in Japan'
$\rightsquigarrow \lambda i \in I[\textsc{JonInJapan}(i)]$

(8) Zyon-ga Nihon-ni ik-
Jon-NOM Japan-LOC go
'Jon go to Japan'
$\rightsquigarrow \lambda e \in E[\textsc{JonToJapan}(e)]$

2.3. Aspectual operators

Next up in the structure in (6) is a slot for aspectual operators. The suffix '*-tei*' mentioned above is one of these operators; we also assume, following KM11, that sentences which do not have an overt operator in this location have a covert one.[7] Semantically, aspectual operators map properties of intervals or events to binary relations between intervals. We use the symbols in (9) for relations between intervals, in addition to the "strict precedence" relation already defined in the model (see also Allen, 1983).

(9) **Relations between intervals**
a. $i \varnothing j := i < j \vee j < i$ [non-overlap]
b. $i \Subset j := \exists k, l[k \subseteq j \wedge l \subseteq j \wedge k < i < l]$ [non-initial, non-final subinterval]

These relations are used in the translations of the aspectual operators. We adopt from KM11 the convention of using the names φ and ρ for variables over properties of intervals and properties of events, respectively.[8]

[7] This simplifies the lexical entries of morphemes (such as tenses) that can combine with sentence radicals both directly and via the mediation of aspectual operators.

[8] We deviate slightly from KM11's definition of $\emptyset$ for non-statives: their $\tau(e) \subseteq j$, corresponds to our $j = \tau(e)$.

(10) **Aspectual operators**

a. $\emptyset \rightsquigarrow \lambda\varphi_{\langle i,t\rangle}\lambda i\lambda j[\varphi(j) \wedge [i \neq s \rightarrow i \Subset j]] \cup$
$\lambda\rho_{\langle \epsilon,t\rangle}\lambda i\lambda j[\exists e[\rho(e) \wedge j = \tau(e)] \wedge i \varnothing j]$

b. ‘*-tei-*’ $\rightsquigarrow \lambda\rho_{\langle \epsilon,t\rangle}\lambda i\lambda j[\exists e[\rho(e) \wedge \boxed{\textsc{tei}(e,j)}] \wedge [i \neq s \rightarrow i \Subset j]]$

At this point the expression “$\textsc{tei}(e,j)$” is just a placeholder. We return to this issue in Section 3, where we fill in the details that explain why ‘*tokoro*’ can have a temporal interpretation with the Progressive reading but not with the Perfect reading of ‘*-tei-*’. For now, we are more interested in the last conjunct of the formula in (10b), which establishes the relationship between the two intervals i, j. If i is not the speech time (i.e., in embedded contexts), it must be contained in j, otherwise (i.e., in matrix contexts) it is not so constrained. This condition mirrors the one imposed by the covert aspectual operator for lexical statives (the upper line in (10a)). This is the sense in which we think it correct to say that clauses modified by ‘*-tei-*’ are (derived) **statives**, regardless of whether the reading is Progressive or Perfect. The result of applying these aspectual operators to sentence radicals in (7) and (8) is given in (11).

(11) Zyon-ga nihon-ni { a. i-∅ / b. ik-∅ / c. it-tei }
Jon-NOM Japan-LOC be go go-TEI
Jon { be in / go to / go-TEI to } Japan

a. $\rightsquigarrow \lambda i\lambda j[\textsc{JonInJapan}(j) \wedge [i \neq s \rightarrow i \Subset j]]$

b. $\rightsquigarrow \lambda i\lambda j\exists e[\textsc{JonToJapan}(e) \wedge j = \tau(e) \wedge i \varnothing j]$

c. $\rightsquigarrow \lambda i\lambda j[\exists e[\textsc{JonToJapan}(e) \wedge \boxed{\textsc{tei}(e,j)}] \wedge [i \neq s \rightarrow i \Subset j]]$

2.4. Tense

Next up in our structure (6) are the tenses. As mentioned above, there are two tenses in Japanese, Nonpast and Past, typically expressed on verbs with some allomorph of ‘*-ru*’ and ‘*-ta*’, respectively, except for the copula, whose forms are ‘*-da*’ and ‘*-datta*’.[9]

(12) **Tenses**

a. NONPAST $\rightsquigarrow \lambda i\lambda j[i \leq j]$ b. PAST $\rightsquigarrow \lambda i\lambda j[j < i]$

(13) Zyon-ga nihon-ni { a. i-ru / b. i-ta / c. ik-u / d. it-ta / e. it-tei-ru / f. it-tei-ta }
Jon-NOM Japan-LOC be-NP be-P go-NP go-P go-TEI-NP go-TEI-P
‘Jon {is in / was in / is going to / went to / . . . } Japan’

a. $\rightsquigarrow \lambda i\lambda j[\textsc{JonInJapan}(j) \wedge i \leq j \wedge [i \neq s \rightarrow i \Subset j]]$

b. $\rightsquigarrow \lambda i\lambda j[\textsc{JonInJapan}(j) \wedge j < i \wedge [i \neq s \rightarrow i \Subset j]]$[10]

c. $\rightsquigarrow \lambda i\lambda j[\exists e[\textsc{JonToJapan}(e) \wedge j = \tau(e)] \wedge i < j]$

d. $\rightsquigarrow \lambda i\lambda j[\exists e[\textsc{JonToJapan}(e) \wedge j = \tau(e)] \wedge j < i]$

e. $\rightsquigarrow \lambda i\lambda j[\exists e[\textsc{JonToJapan}(e) \wedge \boxed{\textsc{tei}(e,j)}] \wedge i \leq j \wedge [i \neq s \rightarrow i \Subset j]]$

f. $\rightsquigarrow \lambda i\lambda j[\exists e[\textsc{JonToJapan}(e) \wedge \boxed{\textsc{tei}(e,j)}] \wedge j < i \wedge [i \neq s \rightarrow i \Subset j]]$[10]

[9] One class of adjectives also carries tense, expressed with ‘*-i*’ and ‘*-katta*’ for Nonpast and Past, respectively. The negative suffix ‘*-na{-i/-katta}*’ belongs to this paradigm.

[10] Notice that (13b,f) imply that $i = s$, in line with the observation that Past statives only occur in matrix contexts.

2.5. Embedding environments

Next up we now reach the position filled by '*tokoro*' or other embedding temporal expressions, such as '*toki*' 'when', '*mae*' 'before', etc. It is instructive to compare several such items to '*tokoro*'. In (14) we give four examples along with their interpretations from KM11.

(14) a. mae 'before' $\rightsquigarrow \lambda\varphi_{\langle i,\langle i,t\rangle\rangle}\lambda h\lambda i\exists j[\varphi(i)(j) \wedge i < j]$
b. ato 'after' $\rightsquigarrow \lambda\varphi_{\langle i,\langle i,t\rangle\rangle}\lambda h\lambda i\exists j[\varphi(i)(j) \wedge j < i]$
c. uti 'while' $\rightsquigarrow \lambda\varphi_{\langle i,\langle i,t\rangle\rangle}\lambda h\lambda i\exists j[\varphi(i)(j) \wedge i \Subset j]$
d. toki 'when' $\rightsquigarrow \lambda\varphi_{\langle i,\langle i,t\rangle\rangle}\lambda h\lambda i\exists j[\varphi(i)(j)]$

All of these items are of the same type, viz. $\langle\langle i,\langle i,t\rangle\rangle,\langle i,\langle i,t\rangle\rangle\rangle$ (i.e., modifiers of binary relations between intervals). Their arguments are the denotations of tensed sentences – relations between intervals i, j which, in matrix sentences, are interpreted as the speech time and the reference time, respectively. In (14) we see that a new time is introduced when tensed sentences are embedded under temporal connectives. The idea is that now h, i are interpreted as the speech and reference time of the matrix sentence, and i anchors the temporal interpretation of the embedded clause. The relation that the embedded sentence imposes on i, j is now, in Reichenbachian terms, imposed on the reference time and event time of the embedded clause.

The semantic contribution of most of the items in (14) is an added condition on the temporal relation between i, j (an exception is '*toki*', which does not add any new constraint). This condition is conjoined with whatever the complement clause already requires of the two intervals. The result may be a contradiction, resulting in ill-formedness (e.g., in the case of '*mae*' 'before' with Past tense or '*ato*' 'after' with Nonpast). Some or the results are shown in (15) and (16).

(15) Zyon-ga nihon-ni { a. ik-u / b. *it-ta } mae
Jon-NOM Japan-LOC go-NPST go-PST before
'before Jon {goes / went} to Japan'
a. $\rightsquigarrow \lambda h\lambda i\exists j[\exists e[\textsc{JonToJapan}(e) \wedge j = \tau(e)] \wedge i < j \wedge i < j]$ ✓
b. $\rightsquigarrow \lambda h\lambda i\lambda j[\exists e[\textsc{JonToJapan}(e) \wedge j = \tau(e)] \wedge i < j \wedge j < i]$ ✗

(16) Zyon-ga nihon-ni i-ru { a. *mae / b. *ato / c. uti / d. toki }
Jon-NOM Japan-LOC be-NPST before after while when
'{before / after / while / when} Jon {is / was} in Japan'
a. $\rightsquigarrow \lambda h\lambda i\exists j[\textsc{JonInJapan}(j) \wedge i < j \wedge i \Subset j]$ ✗
b. $\rightsquigarrow \lambda h\lambda i\exists j[\textsc{JonInJapan}(j) \wedge j < i \wedge i \Subset j]$ ✗
c. $\rightsquigarrow \lambda h\lambda i\exists j[\textsc{JonInJapan}(j) \wedge i \Subset j \wedge i \Subset j]$ ✓
d. $\rightsquigarrow \lambda h\lambda i\exists j[\textsc{JonInJapan}(j) \wedge i \Subset j]$ ✓

Table 1 shows the overall pattern resulting from the interaction between the various temporal constraints. *iku* 'go' and *iru* 'be' are non-stative and stative, respectively. The rightmost column shows the data with '*tokoro*' that we outlined earlier. Our goal is to add a semantic entry for '*tokoro*', replacing the question marks in the top row.

Table 1: Temporal constraints contributed by temporal connectives (top row) and their clausal complements (left column), and the resulting well-/ill-formedness of the combinations.

		mae 'before' $i < j$	ato 'after' $j < i$	uti 'while' $i \Subset j$	toki 'when' ·	tokoro ???
ik-u	$i < j$	'before'	*	*	'before'	'right before'
it-ta	$j < i$	*	'after'	*	'after'	'right after'
it-tei-ru$_{\text{PROG}}$	$i \Subset j$	*	*	'while'	'while'	'while'
it-tei-ru$_{\text{PERF}}$	$i \Subset j$	*	*	'while'	'while'	*/cf
i-ru	$i \Subset j$	*	*	'while'	'while'	*/cf
i-ta	✗	*	*	*	*[11]	*

There are three major challenges to this project. First, as seen in the table, '*tokoro*' is sensitive to a distinction that the other particles do not track, distinguishing between the upper three rows (Nonstative *ik-u/it-ta* 'go'; Progressive reading of '*-teiru*') and the lower rows (Stative *i-ru/i-ta* 'to be', and Perfect reading of '*-teiru*'). None of the other connectives is sensitive to this distinction, nor is it expressed in the relation between the intervals i, j, which was sufficient to account for the patterns discussed so far. Secondly, '*tokoro*' adds a connotation of "immediacy" to the temporal relations in the top rows, which our rendering in English as 'right before' and 'right after' is intended to convey. Finally, '*tokoro*' alone has a counterfactual reading in cases in which a temporal reading is unavailable.

3. Analysis

We address the challenges just discussed in terms of an interaction between '*tokoro*''s aspectual properties and a certain notion of "immediacy." For instance, recall that with non-stative complements, '*tokoro*' comes to mean 'right before' or 'right after', depending on the embedded tense. We want to formalize this notion in such a way that the more peculiar properties of '*tokoro*' – its well-formedness with Progressive but not with Perfect '*-teiru*' and the availability of a counterfactual reading with Perfect '*-teiru*' and statives – also fall out.

One way to describe the peculiar behavior of '*tokoro*' in combination with '*-teiru*' is that on the Progressive reading of '*-teiru*' these sentences behave like non-statives, whereas on the Perfect reading they behave like statives. We need to explain, not only why one and the same morpheme, '*-tei-*', can have such disparate uses, but also why on the Progressive use it has a certain eventive "flavor" which is absent from the Perfect use.

What is this eventive "flavor," and how should it be represented? It is a widely held view that events involve **change** or **development** of some kind, and that their progress can be **measured**

[11] Past statives can in principle occur in embedding contexts, but only with an **absolute** reading of the Past tense (i.e., one anchored to the speech time rather than the matrix reference time). Whether such a reading is available depends on the embedding connective. It is not available under '*tokoro*', therefore we ignore it in this paper. It is available under '*toki*', hence the asterisk in the corresponding cell in our table is a simplification. See Kaufmann and Miyachi (2011) for details.

in various ways, whereas states have none of those properties. The stative/non-stative distinction is often taken to be an ontological fact about different kinds of enventualities (Smith, 1991; Bach, 1986[12]); the notion that events can be measured is discussed and formalized in various ways depending on whether the measurement draws on incremental themes, expressions of creation, changes of state or degree, paths, or yet some other notion (Dowty, 1991; Krifka, 1989, 1992; Tenny, 1994; Hay et al., 1999; Kennedy and Levin, 2008, *i.a.*).

In this paper we stop short of committing ourselves to a particular view on the origins of event measurement. We are more interested in the question of how, once such measurement is introduced, it can have repercussions throughout the compositional process. For recall that '*tokoro*' does not combine directly with event-denoting sentence radicals, and not even with '*radical+-tei*' compounds. Instead, it combines with tensed clauses, and we have been assuming throughout that tensed clauses denote binary relations between temporal intervals. Since there is no direct link to the underlying eventualities, the "eventive flavor" of the Progressive cannot be implemented straightforwardly in terms of the denotatum of '*tokoro*''s complement. Instead, we need a way to let the stative/non-stative distinction that is accessible lower in the derivation leave an "imprint" on the intervals higher up.

To implement this, we enrich our representation of temporal traces. We do this in two steps: in Section, 3.1, give '*-tei-*' access to different phases of an event (*viz.* its run-time and its result state, where available); in Section 3.2 we add a representation of event measurement.

3.1. The versatility of '*-tei-*'

While space does not permit us to do justice to the extensive literature on '*-tei-*', we do need to introduce the basic facts about its semantic versatility. Most discussions of '*-tei-*' distinguish at least three readings: Progressive, Resultative Perfect, and Experiential Perfect. Which of them are available for a particular sentence containing '*-tei-*' depends on the prejacent's aspectual properties (and possibly other factors). The clearest cases exhibiting all readings are accomplishments with an activity phase and a result state. The examples in (17) are from Igarashi and Gunji (1998), adjusted to our transliteration and glosses. (17a,b) illustrate the Progressive and Resultative Perfect readings, as highlighted by the English glosses. In (17c), the combination of the past adverbial '*sannen mae-ni*' 'three years ago' with Nonpast tense forces the Experiential Perfect reading (Fujii, 1976; Ogihara, 1998).

(17) a. Ken-wa ima tonari-no heya-de kimono-wo ki-tei-ru [PROG]
Ken-TOP now next-GEN room-LOC kimono-ACC put on-TEI-NPST
'Ken is now putting on a kimono in the next room'

b. Ken-wa kesa kara zutto ano kimono-wo ki-tei-ru [RESULT]
Ken-TOP this morning from always that kimono-ACC put on-TEI-NPST
'Ken has been wearing that kimono since this morning'

[12]Bach distinguishes states, processes and events, with the latter two being subsumed under the class of "non-states." We use the labels "non-stative" and "eventive" interchangeably.

c. Ken-wa ano kimono-wo sannen mae-ni ki-tei-ru [EXP]
Ken-TOP that kimono-ACC three years before-LOC put on-TEI-NPST
(i) 'Ken has the experience of putting on that kimono three years ago' [EXP I]
(ii) 'Ken has the experience of wearing that kimono three years ago' [EXP II]

Igarashi and Gunji (1998) argue that the Experiential (17c) can actually have two readings, depending on which of the two phases of the accomplishment – the putting on or the wearing of the kimono – is said to have taken place in the past. The two translations in (17c) are meant to bring out that difference. Gunji (2004) puts even more emphasis on this distinction, extending the traditional tripartite taxonomy by treating the two variants of the Experiential Perfect as distinct (though related) readings. This allows him to account for the full picture in terms of the interplay between two independent dimensions of variation: Activity vs. Result State reading of the prejacent, and Ongoing vs. Anterior reading of '-*tei*-'.[13] The competing view of the traditional tripartite taxonomy is that the distinction between Activity and Resultative reading of the prejacent is only relevant under the Ongoing reading of '-*tei*-', but neutralized under its Anterior reading (Ogihara, 1998).

We adopt (Igarashi and) Gunji's position that there is a major distinction between the Progressive and Resultative Perfect reading on the one hand, and the Experiential reading(s) on the other.[14] This distinction seems related to a grammatical difference, as shown by the ability of past adverbials to co-occur with Present tense only under the Experiential reading.[15] We stop short of postulating two distinct readings of the Experiential, however. This is in part because space is limited and a formal implementation which draws the distinction would require further modifications to the framework. Moreover, most informants report having a hard time seeing a clear semantic difference between the two readings. For the purposes of this paper, at least, we treat (17c) as one reading in which the Activity/Result State distinction is neutralized.

For our formal analysis, this means that we need to encode two distinctions: the Activity/Result State distinction for the prejacent, and the Ongoing/Anterior distinction for '-*tei*-'. Furthermore, we follow those who assume that the two distinctions are not independent: Activity and Result State are only distinguished under Ongoing '-*tei*-'. Finally, we want to account for the fact that past adverbials can occur with Nonpast tense under Anterior but not Ongoing '-*tei*-'.

[13] Gunji uses different terminology: at both levels, he distinguishes a **basic** view (基本視野; in our terminology, Activity at the level of the precedent and Ongoing at the level of '-*tei*-') from a **stative** view (状態視野, our Result State (prejacent) and Anterior ('-*tei*-')). We prefer our terminologoy for its mnenomic value (for us), but nothing hinges on this choice. Notice also that Gunji considers '-*tei*-' complex. He attributes the Ongoing/Anterior distinction to the semantics of '-*te*-' alone, while taking '*i*' to be semantically inert.

[14] A separate class of approaches, which we do not discuss in detail here, seeks to unify the Resultative Perfect and the Experiential Perfect reading, setting them apart from the Progressive. See Ogihara (1998) for discussion.

[15] Past adverbials **can** modify sentences with '-*tei*-' under the other readings, but only if the matrix tense is Past:

(i) Ken-wa ano kimono-wo sannen mae-ni ki-tei-ta
Ken-TOP that kimono-ACC three years before-LOC wear-TEI-PST
'Ken was { putting on / wearing } that kimono three years ago.'

These cases do not pose a problem for our analysis on the assumption that the adverb here has '-*tei*-' in its scope, rather than *vice versa*.

We start with Ongoing '*-tei-*' and the two readings it gives rise to. Our preliminary definition of '*-tei-*' from (10b) is repeated below.

(10b) (*preliminary*) $\lambda\rho_{\langle\epsilon,t\rangle}\lambda i\lambda j[\exists e[\rho(e) \wedge \boxed{\textsc{tei}(e, j)}] \wedge [i \neq s \rightarrow i \Subset j]]$

We now need to spell out the expression $\textsc{tei}(e, j)$ in the box in (10b). The idea is that '*-tei-*' makes the inner stages of an event available for linguistic reference. We could simply replace the the box with the condition that $j = \tau(e)$, thus locating i within the runtime of the event in embedded contexts. However, this would only make the Progressive interpretation available, not the Perfect.

To add the Perfect, we adapt from Igarashi and Gunji (1998); Gunji (2004) the main idea behind their classification. In principle, not one but two intervals can be associated with an event in the extension of a sentence radical: one is the familiar temporal trace of the event itself, the other is the interval over which its result state holds.[16] Whether both of these intervals are available depends on the aspectual class: activities have no lexically encoded result state, whereas achievements may have a result state but no temporal extension in the triggering change-of-state event (i.e., no interval corresponding to an Activity part). Consequently, under '*-tei-*', activities typically only have Progressive readings and achievements only Result state readings, whereas accomplishments can have both.

Formally, we define an **extended temporal trace** function τ^+ from events to sets of (one or two) intervals. The intention is that $\tau^+(e)$ is true of the conventional temporal trace $\tau(e)$ but also of the maximal interval of which e's result state holds, in case the latter is defined. In (18) we use the auxiliary notation *result* for the partial function mapping events to their result states.[17]

(18) **Extended temporal trace**
For all events e, $\tau^+(e) := \lambda i[i = \tau(e) \vee \exists j[j = \mathit{result}(e) \wedge i = j]]$

Our definition for Ongoing '*-tei-*' draws on this notion:

(19) '*-tei-*' $_{\textsc{ong}} \rightsquigarrow \lambda\rho_{\langle\epsilon,t\rangle}\lambda i\lambda j[\exists e[\rho(e) \wedge \tau^+(e)(j)] \wedge [i \neq s \rightarrow i \Subset j]]$

We now turn to the Anterior reading of '*-tei-*'. What would seem to be the most straightforward way to include this reading – by modifying (19) to allow for the case that $j < i$ – is not viable.

[16] Note that Igarashi and Gunji's implementation differs from ours: their constraints refert to the boundaries of the intervals in question, calling them the "start time" and "finish time" of the event (the latter also serving as the start time of the result state, where applicable), and the "reset time" marking the end of the result state. Aside from this difference, and modulo further fine distinctions that we cannot go into for lack of space, the intuitions are similar to our implementation, as far as we can see.

[17] This way of implementing the idea has certain consequences for the underlying notion of events. Ogihara (Ogihara, 1998, p. 96) points out that two different descriptions of the same state of affairs can have different aspectual properties. For instance, different sentences referring to the same opening of a door may or may not have Progressive readings depending on the grammatical form. This means that the value of $\tau^+(e)$ may differ depending on the sentence used. In order to avoid untoward consequences of this possibility (e.g., ensuring that τ^+ is a function), we have to assume that in such cases the model actually contains two distinct events representing the very same opening of the door which can serve as denotations of the different linguistic expressions.

This is because Anterior '-*tei*-' allows for the coexistence of past adverbs like '*kyonen*' 'last year' with Nonpast tense. In our framework, this would mean that the adverb places j within the year preceding that of the speech time, while the Nonpast tense rules out the possibility that j precedes i, leading to contradictory constraints in matrix contexts (where i ends up referring to the speech time). We avoid this unwelcome consequence by giving Anterior '-*tei*-' a denotation of an altogether different type and assuming that in the syntactic derivation it behaves in some respects more like a tense than an aspectual operator. Specifically, we assume that it co-occurs with, and outscopes, the covert aspectual operator $\emptyset$. Consequently, its complement denotes a relation between intervals, not a property of events, and this makes it possible for temporal adverbs to scope lower than '-*tei*-'. At the same time, as seen in the denotation in (20b), '-*tei*-' introduces an additional interval k at which the prejacent φ is evaluated and which can be constrained by temporal adverbs. The tense above '-*tei*-', meanwhile, constrains the relation between i and j. Thus past adverbs and present tense may co-occur without contradiction.[18]

(20) a. '-*tei*-' $_{\text{ONG}} \rightsquigarrow \lambda\rho_{\langle\epsilon,t\rangle}\lambda i\lambda j[\exists e[\rho(e) \wedge \tau^+(e)(j)] \wedge [i \neq s \rightarrow i \Subset j]]$
b. '-*tei*-' $_{\text{ant}} \rightsquigarrow \lambda\varphi_{\langle\langle i,t\rangle,\langle\langle i,t\rangle,t\rangle\rangle}\lambda i\lambda j[\exists k[\varphi(j)(k) \wedge k < j] \wedge [i \neq s \rightarrow i \Subset j]]$

We illustrate with a few examples. (21) is a matrix sentence with the temporal adverb '*kyonen*' 'last year'. (21a) shows the denotation (the conditions imposed by Present or Past tense are listed in the last conjunct) which is then evaluated at the speech time s (fixed by the model) and reference time r (contributed by context). In this case the two constraints contributed by LASTYEAR and tense are imposed on the same pair of intervals s, r. The ill-formedness of the Present-tense variant arises at this point due to the inconsistency of $\text{LASTYEAR}(s)(r)$ and $s \leq r$.[19]

(21) Kyonen kimono-wo ki- { *ru / ta }
last year kimono-ACC wear NPST PST
[[kyonen [[kimono-wo ki] $\emptyset$]] { *ru / ta }]
a. $\rightsquigarrow \lambda i\lambda j[\exists e[\text{KIMONOKI}(e) \wedge j = \tau(e)] \wedge i \varnothing j \wedge \text{LASTYEAR}(s)(j) \wedge \{i \leq j / j < i\}]$
(21a)$(s)(r) \Leftrightarrow \exists e[\text{KIMONOKI}(e) \wedge r = \tau(e)] \wedge \text{LASTYEAR}(s)(r) \wedge r < s$

We next turn to '-*tei*-'. For ease of exposition, we list examples of its Ongoing and Anterior use separately. The surface strings are indistinguishable, but we indicate the respective intended derivations in the bracketed representations. First consider Ongoing '-*tei*-', which due to its type must combine directly with the sentence radical and scope under the temporal adverb. Only the Past-tense variant of the sentence can have this reading; the Nonpast is ruled out in the same way as the Nonpast of (21) above. Which readings (Activity and/or Result State Perfect) (22) can have depends on which intervals are made available by the extended temporal trace $\tau^+(e)$. Which reading it has in any particular instance further depends on how $\tau^+(e)$ applies

[18]The reader may notice that according to (20b) the "high" '-*tei*-' has the same type as the tenses – both are modifiers of binary relations between structured intervals. This means that the denotations do not by themselves enforce the observed structural relationship, i.e., that tense invariably sits higher in the syntactic tree than '-*tei*-'. We assume that this relationship is enforced independently by syntactic factors.

[19]Note that it is not the past reference *per se* that is incompatible with Present tense. For instance, embedded under connectives like '*toki*' 'when' and '*mae*' 'before', Present tense is not interpreted as restricting s, r and can thus happily coexist with past intervals like '*kyonen*'.

to j (ultimately, r): it is a (non-initial and non-final) subinterval of either $\tau(e)$, giving rise to the Activity reading, or of *result*(e), corresponding to the Result State Perfect reading.

(22) Kyonen kimono-wo ki-tei$_{\text{ONG}}$- { *ru / ta }
last year kimono-ACC wear-TEI NPST PST
[[kyonen [[kimono-wo ki] tei]] ta] [PAST ACTIVITY/PAST RESULT]
a. $\rightsquigarrow \lambda i \lambda j[\exists e[\text{KimonoKi}(e) \wedge \tau^{+}(e)(j)] \wedge \text{LASTYEAR}(s)(j) \wedge j < i]$
$(22a)(s)(r) \Leftrightarrow \exists e[\text{KimonoKi}(e) \wedge \tau^{+}(e)(r)] \wedge \text{LASTYEAR}(s)(r) \wedge r < s$

For the Anterior reading of ‘*-tei-*’, we do not predict that past adverbs with Nonpast tense result in inconsistency. This is shown in (23).

(23) Kyonen kimono-wo ki-tei$_{\text{ANT}}$-ru
last year kimono-ACC wear-TEI-NPST
[[[kyonen [[kimono-wo ki] ∅]] tei] ru] [PRES EXP]
a. $\rightsquigarrow \lambda i \lambda j \exists k[\exists e[\text{KimonoKi}(e) \wedge k = \tau(e)] \wedge k \varnothing j \wedge \text{LASTYEAR}(s)(k) \wedge k < j \wedge i \leq j]$
$(23a)(s)(r) \Leftrightarrow \exists k[\exists e[\text{KimonoKi}(e) \wedge k = \tau(e)] \wedge \text{LASTYEAR}(s)(k) \wedge k < r \wedge s \leq r]$

But we do not predict Anterior ‘*-tei-*’ to be inconsistent with Past tense either. In fact, we derive two readings for (24), corresponding to two positions of the adverb relative to ‘*-tei-*’. On the reading in (24a/b), the adverb restricts k, the event of putting on the kimono; the reference time r, which must lie strictly between k and s, is thus a time at which the experiential state holds. On this interpretation the sentence means that at some point in the recent past (say, a week ago) it was true (or it turned out) that the subject had worn a kimono last year. On the reading in (24c/d) the adverb restricts the reference time r, while the time k of wearing the kimono must be found at an even earlier time. In other words, it turned out last year that (already then) the subject had the experience of having worn a kimono. We take it that both readings exist.

(24) Kyonen kimono-wo ki-tei$_{\text{ANT}}$-ta
last year kimono-ACC wear-TEI-PST
a. [[[kyonen [[kimono-wo ki] ∅]] tei] ta] [PAST EXP]
b. $\rightsquigarrow \lambda i \lambda j \exists k[\exists e[\text{KimonoKi}(e) \wedge k = \tau(e)] \wedge k \varnothing j \wedge \text{LASTYEAR}(s)(k) \wedge k < j \wedge j < i]$
$(24a)(s)(r) \Leftrightarrow \exists k[\exists e[\text{KimonoKi}(e) \wedge k = \tau(e)] \wedge \text{LASTYEAR}(s)(k) \wedge k < r \wedge r < s]$
c. [[kyonen [[[kimono-wo ki] ∅] tei]] ta] [PAST EXP]
d. $\rightsquigarrow \lambda i \lambda j \exists k[\exists e[\text{KimonoKi}(e) \wedge k = \tau(e)] \wedge k \varnothing j \wedge k < j \wedge \text{LASTYEAR}(s)(j) \wedge j < i]$
$(24c)(s)(r) \Leftrightarrow \exists k[\exists e[\text{KimonoKi}(e) \wedge k = \tau(e)] \wedge k < r \wedge \text{LASTYEAR}(s)(r) \wedge r < s]$

3.2. Event measurement

Tradionally, the temporal trace of an event has been taken to be an interval (assigned to the event by the function τ, Krifka (1989)), and we have followed this convention thus far. The left-hand side of Figure 1 is an illustration. We propose a straightforward modification of this simple picture: The temporal trace function $\tau_{\mathbf{S}}$ maps events to **structured intervals**, our term for sets

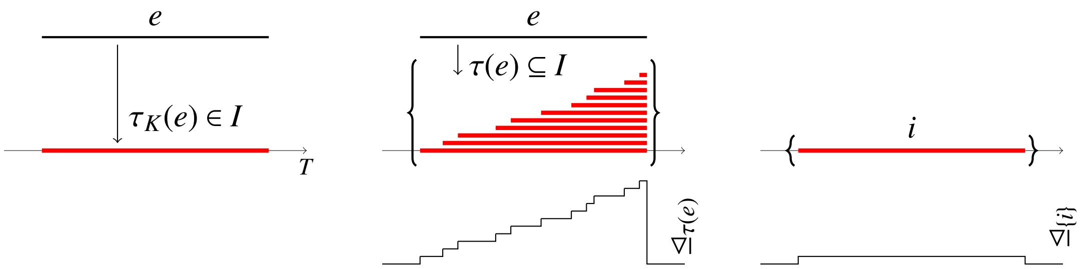

Figure 1: Left: Temporal trace τ mapping events to intervals. Middle: Temporal trace τ_S mapping events to structured intervals (top) and induced order $\trianglelefteq_{\tau(e)}$ on T (bottom). Right: Stative denotation i (top) and pre-order $\trianglelefteq_{\{i\}}$ on T (bottom).

of intervals which contain their own union.[20] In our type-theoretic compositional framework, structured intervals are represented by their characteristic functions, i.e., in $D_{\langle i,t\rangle}$, and we use variables **i**, **j**, etc. to range over them. For ease of exposition, we switch between talk of these characteristic functions and the sets of intervals they characterize, using variables like $\mathbf{A},\mathbf{B}$, *etc.* for the latter. No confusion should result from this.

(25) A set $\mathbf{A}$ of intervals is a **structured interval** iff $\cup\mathbf{A}$ is an element of $\mathbf{A}$.

The relations between intervals defined above can be extended to stuctured intervals straightforwardly as follows:

(26) $\mathbf{A} < \mathbf{B} := \cup\mathbf{A} < \cup\mathbf{B} \quad \mathbf{A} \varnothing \mathbf{B} := \cup\mathbf{A} \varnothing \cup\mathbf{B} \quad \mathbf{A} \Subset \mathbf{B} := \cup\mathbf{A} \Subset \cup\mathbf{B} \quad \mathbf{A} \supset\!\subset \mathbf{B} := \cup\mathbf{A} \supset\!\subset \cup\mathbf{B}$

The shift from simple to structured temporal traces does not affect their durations, just their internal structure. Thus we assume that each $\tau_{\mathbf{S}}(e)$ contains $\tau(e)$ as its greatest element.

(27) A **structured temporal trace** is a function $\tau_{\mathbf{S}}$ mapping events to structured intervals, subject to the condition that for all events e, $\tau(e) = \cup\tau_{\mathbf{S}}(e)$.

Next, we use sets of intervals to derive a pre-order on the entire set T of times as in (28).[21] For our example in Figure 1, the relative ranking of the equivalence classes of the pre-order induced by $\tau(e)$ is shown in the lower middle graph.

(28) **Induced pre-order on *T***
Let A be a set of intervals. The pre-order $\trianglelefteq_A$ on T induced by A is defined as follows: $t \trianglelefteq_A t'$ iff all intervals in A which contain t also contain t'.

[20]In fact, the structured intervals we consider here are **nests** of **final** subintervals; but we refrain from imposing those stronger properties by definition since nothing in our proposal depends on them.
[21]This notion of an induced pre-order is inspired by Kratzer's treatment of modality (Kratzer, 1981, *i.a.*); but notice that here the order is reversed, in the sense that times that are contained in more intervals are ranked higher, rather than lower.

This latter change also affects the interpretation of statives. Recall from above that they were mapped to properties of intervals. This remains unchanged, but now what gets passed up in the compositional process is the singleton sets containing those intervals. Singleton sets of intervals induce single-step pre-orders as shown on the right-hand side in Figure 1. There, all points in i are ranked equally and strictly higher than any point outside of i. This is in line with the intuition that the denotations of statives do not involve any notion of change or development.

The switch to set-valued temporal traces requires minor adjustments to the overall system. Recall that our goal is to allow for expressions higher up in the syntactic tree, such '*tokoro*', which do not directly compose with event-denoting sentence radicals, to have access to the structure of the temporal traces despite the intervening tenses (and possibly other temporal/aspectual material). We achieve this by generalizing to the worst case, as it were, using structured intervals throughout the compositional process. For the most part, that change is insignificant. For instance, the denotation of the covert aspectual operator '$\emptyset$', first given in (10a) above, changes to (29). The upper line, for stative complements, requires that there be an interval k of which φ is true and such that $\mathbf{j}$ is the singleton set containing k. The lower line, for non-statives, now implies that $\mathbf{j}$ encodes the structure of e. However, this information about the structure of e leaves no imprint on $\mathbf{i}$, since $\mathbf{i}$ and $\mathbf{j}$ are required to be disjoint.

(29) $\emptyset \quad \rightsquigarrow \lambda\varphi_{\langle i,t\rangle}\lambda\mathbf{i}\lambda\mathbf{j}\exists j[\varphi(j) \wedge \mathbf{j} = \lambda k[k = j]] \wedge [\mathbf{i} \neq \mathbf{s} \rightarrow \mathbf{i} \Subset \mathbf{j}]] \cup$
$\lambda\rho_{\langle\epsilon,t\rangle}\lambda\mathbf{i}\lambda\mathbf{j}[\exists e[\rho(e) \wedge \mathbf{j} = \tau_{\mathbf{S}}(e)] \wedge \mathbf{i} \varnothing \mathbf{j}]$

In fact, to keep things simple, it is a good idea to assume that the structured intervals used in the derivation are generally singleton **unless** they are non-trivially structured by the temporal trace of an event. Formally, this can be done by defining a predicate in the translation language that is true of structured intervals just in case they are singleton (e.g., SG($\mathbf{i}$) := $\exists i[\mathbf{i} = \lambda j[j = i]]$) and assert this predicate of all the intervals that are not used to record event measurement (i.e., $\mathbf{i}$ in (29), $\mathbf{j}$ in (31a), and both $\mathbf{i}$,$\mathbf{j}$ in (31b)). We refrain from doing so in the interest of readability, but we do make the assumption that the structured intervals are singleton unless stated otherwise, and this assumption will in fact be significant below.

For the denotation of '*-tei-*', we redefine the notion of an extended temporal trace. Recall from (18) above that $\tau^+(e)$ is the property of being either the traditional temporal trace $\tau(e)$ or the result state *result*(e). From τ^+ and the notion of a structured temporal trace $\tau_{\mathbf{S}}$ we now define a function mapping events to properties of structured events: $\mathbf{T}(e)$ is the property of being either the structured trace $\tau_{\mathbf{S}}(e)$ or the singleton set *result*(e).

(30) Let τ^+ be an extended temporal trace function and $\tau_{\mathbf{S}}$ a structured temporal trace function defined on the same domain. The corresponding **extended structural temporal trace** function $\mathbf{T}$ maps events to properties of structured intervals as follows:
$\mathbf{T}(e) = \lambda\mathbf{i}[\mathbf{i} = \tau_{\mathbf{S}}(e) \vee \exists j[j = result(e) \wedge \mathbf{i} = \lambda k[k = j]]]$

With this notion in place, we adjust our definition of '*-tei-*' to structured intervals as in (31).

(31) a. '*-tei-*' $_{\text{ONG}} \rightsquigarrow \lambda\rho_{\langle\epsilon,t\rangle}\lambda\mathbf{i}\lambda\mathbf{j}[\exists e[\varphi(e) \wedge \mathbf{T}(e)(\mathbf{j})] \wedge [\mathbf{i} \neq \mathbf{s} \rightarrow \mathbf{i} \Subset \mathbf{j}]]$
b. '*-tei*' $_{\text{ANT}} \rightsquigarrow \lambda\varphi_{\langle\langle i,t\rangle,\langle\langle i,t\rangle,t\rangle\rangle}\lambda\mathbf{i}\lambda\mathbf{j}\exists\mathbf{k}[\varphi(\mathbf{j})(\mathbf{k}) \wedge \mathbf{k} < \mathbf{j} \wedge [\mathbf{i} \neq \mathbf{s} \rightarrow \mathbf{i} \Subset \mathbf{j}]$

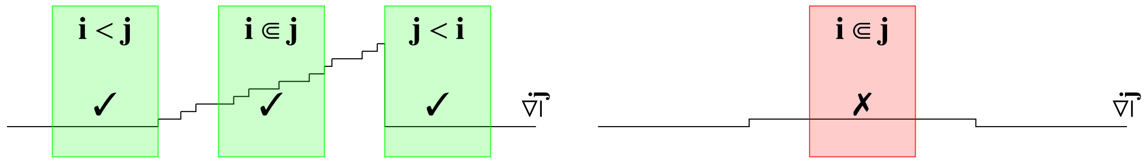

Figure 2: Permissible (left) and excluded (right) positions of **i** relative to the order induced by **j**.

3.3. '*Tokoro*': the uphill condition

'*Tokoro*' takes as its complement a tensed clause, which as we saw denotes a binary relation between structured intervals, constrained by the temporal semantics of the complement. '*Tokoro*' adds a single further condition on the pairs **i**,**j** in this relation: informally put, **i** must be adjacent to an interval with strictly higher "**j**-ness." Somewhat more formally: **i** must abut an interval which ranks strictly higher than **i** on the order induced by **j**. We introduce special terms and notation for this relationship in (32) and give the denotation of '*tokoro*' as in (33).

(32) **Uphill and downhill**
Let **i** and **j** be structured intervals. **i** is **downhill from j** (and **j** is uphill from **i**), written $\mathbf{i}^{\curvearrowright\mathbf{j}}$, iff there is an interval k such that $\cup\mathbf{i} \trianglelefteq_{\mathbf{j}} k$ and $\cup\mathbf{i} \supset\!\subset k$

(33) '*tokoro*' $\rightsquigarrow \lambda\varphi_{\langle\langle i,t\rangle,\langle\langle i,t\rangle,t\rangle\rangle}\lambda\mathbf{h}\lambda\mathbf{i}\exists\mathbf{j}[\varphi(\mathbf{i})(\mathbf{j}) \wedge \mathbf{i}^{\curvearrowright\mathbf{j}}]$

Figure 2 shows various possible locations of **i** relative to an order $\trianglelefteq_{\mathbf{j}}$, all of which may be delivered by the compositional semantics of the prejacent of '*tokoro*'. For instance, the pictures on the left are consistent with the denotations of a non-stative clause with simple Past, Progressive '*-tei-*' plus Present, and simple Present. These options are illustrated in (34) and (35).[22] In (34), where the precedence relation between **i** and **j** is fixed by the tense and aspect of the prejacent, '*tokoro*' strengthens this requirement to **immediate** precedence. In (35), the inclusion of **i** within **j** is ensured by '*-tei-*',[23] and '*tokoro*' imposes in the additional condition that **j** have internal structure, i.e., that it be the temporal trace of an activity (or of the activity phase of an accomplishment). This is the case for the Progressive reading of '*-tei-*'.

(34) Taro-ga { aruku // aruita } tokoro { da / datta }
Taro-NOM walk-NPST walk-PAST TOKORO COP-NPST COP-PAST
'Taro {{is/was} about to walk // {has/had} just walked'}
a. $\lambda\mathbf{h}\lambda\mathbf{i}\exists\mathbf{j}[\exists e[\textsc{TaroAruk}(e) \wedge \mathbf{j} = \tau_{\mathbf{S}}(e)] \wedge \mathbf{i} \varnothing \mathbf{j} \wedge \{\mathbf{i} \leq \mathbf{j} // \mathbf{j} < \mathbf{i}\} \wedge \mathbf{i}^{\curvearrowright\mathbf{j}} \wedge \{\mathbf{h} \leq \mathbf{i} / \mathbf{i} < \mathbf{h}\}]$
(34a)(**s**)(**r**) $\Leftrightarrow$
$\exists\mathbf{j}[\exists e[\textsc{TaroAruk}(e) \wedge \mathbf{j} = \tau_{\mathbf{S}}(e)] \wedge \{\mathbf{r} < \mathbf{j} // \mathbf{j} < \mathbf{r}\} \wedge \mathbf{r}^{\curvearrowright\mathbf{j}} \wedge \{\mathbf{s} \leq \mathbf{r} / \mathbf{r} < \mathbf{s}\}]$

[22] Notice that the matrix tense in these sentences is irrelevant for the present discussion, since it constrains the relation between **h** and **i**, which does not interact with '*tokoro*'.
[23] Here Past tense on the prejacent is ruled out because the position under '*tokoro*' is an embedding context.

(35) Taro-ga arui-tei- { ru // *ta } tokoro { da / datta }
Taro-NOM walk-TEI- NPST PAST TOKORO COP-NPST COP-PST
'Taro {is/was} walking.'
a. $\lambda\mathbf{h}\lambda\mathbf{i}\exists\mathbf{j}[\exists e[\textsc{TaroAruk}(e) \wedge \mathbf{T}(e)(\mathbf{j})] \wedge \mathbf{i} \Subset \mathbf{j} \wedge \{\mathbf{i} \leq \mathbf{j}//\mathbf{j} < \mathbf{i}\} \wedge \mathbf{i}^{\nearrow\mathbf{j}} \wedge \{\mathbf{h} \leq \mathbf{i}/\mathbf{i} < \mathbf{h}\}]$
$(35a)(\mathbf{s})(\mathbf{r}) \Leftrightarrow \exists\mathbf{h}[\exists e[\textsc{TaroAruk}(e) \wedge \mathbf{T}(e)(\mathbf{j})] \wedge \mathbf{r} \Subset \mathbf{j} \wedge \mathbf{r}^{\nearrow\mathbf{j}} \wedge \{\mathbf{s} \leq \mathbf{r}/\mathbf{r} < \mathbf{s}\}]$

Statives, on the other hand, do not have the right temporal denotations to serve as the prejacents of '*tokoro*'. This is shown for lexically statives in (36). Here **i** is placed within **j**, similarly to the Progressive reading available for (35) above; this time, however, the order induced by **j** is flat around **i**, thus the contour condition imposed by '*tokoro*' is not met, as on the right-hand side in Figure 2. The Perfect reading of (35) is ruled out in the same way.

(36) Zyon-ga Nihon-ni { iru // *ita } tokoro { da / datta }
Jon-NOM Japan-LOC be-NPST be-PAST TOKORO COP-NPST COP-PAST
a. $\lambda\mathbf{h}\lambda\mathbf{i}\exists\mathbf{j}[\exists j[\textsc{JonInJapan}(j) \wedge \mathbf{j} = \lambda k[k = j]] \wedge \mathbf{i} \Subset \mathbf{j} \wedge \mathbf{i}^{\nearrow\mathbf{j}} \wedge \{\mathbf{h} \leq \mathbf{i}/\mathbf{i} < \mathbf{h}\}]$
$(36a)(\mathbf{s})(\mathbf{r}) \Leftrightarrow \exists\mathbf{j}[\exists j[\textsc{JonInJapan}(j) \wedge \mathbf{j} = \lambda k[k = j]] \wedge \mathbf{r} \Subset \mathbf{j} \wedge \mathbf{r}^{\nearrow\mathbf{j}} \wedge \{\mathbf{s} \leq \mathbf{r}/\mathbf{r} < \mathbf{s}\}]$

Finally, the Anterior reading of '*-tei-*' is also incompatible with '*tokoro*'. The corresponding structure and interpretation for (35) is shown in (35').

(35') [[[[[[Taro-ga aruk] ∅] tei$_{\text{ANT}}$] {ru/*ta}] tokoro] {da/datta}]
'Taro {has/had} the experience of walking.'
a. $\lambda\mathbf{h}\lambda\mathbf{i}\exists\mathbf{j}\exists\mathbf{k}[\exists e[\textsc{TaroAruk}(e) \wedge \mathbf{k} = \tau_S(e)] \wedge \mathbf{k} < \mathbf{j} \wedge \mathbf{i} \Subset \mathbf{j} \wedge \mathbf{i}^{\nearrow\mathbf{j}} \wedge \{\mathbf{h} \leq \mathbf{i}/\mathbf{i} < \mathbf{h}\}]$
$(36a)(\mathbf{s})(\mathbf{r}) \Leftrightarrow$
$\exists\mathbf{j}\exists\mathbf{k}[\exists e[\textsc{TaroAruk}(e) \wedge \mathbf{k} = \tau_S(e)] \wedge \mathbf{k} < \mathbf{j} \wedge \mathbf{r} \Subset \mathbf{j} \wedge \mathbf{r}^{\nearrow\mathbf{j}} \wedge \{\mathbf{s} \leq \mathbf{r}/\mathbf{r} < \mathbf{s}\}]$

It is worth noting that the formula in (35'a) as it stands does not imply contradiction and ill-formedness, since it does not require **j** to be a singleton structured interval. This is not as it should be, since '*-tei-*' does not in fact have an experiential reading under '*tokoro*' (except for the counterfactual reading, which we do not deal with in this paper). It is here that our assumption that all structured intervals are singleton unless stated otherwise comes into play. We predict the unavailability of this reading if (and since) we assume that **j** in (36) is singleton, even though in the interest of readability we refrain from enforcing this in the formulas.

4. Conclusion

Rather than summarize what we have accomplished in this paper, we mention two things we left for future work. We already mentioned that we did not deal with counterfactual readings of lexical statives and non-Progressive '*-tei-*' under '*tokoro*'. We also did not touch on cases in which contextually given information can rescue a temporal reading. For instance, (37) can have a temporal interpretation even under a resultative reading of '*-tei-*', as indicated by the English gloss, if the state in question occurs as part of a set sequence of eventualities, as for instance in describing which outfit a model is wearing at this point as part of an ongoing fashion show.

(37) Tada ima kimono-wo ki-tei-ru tokoro da.
right now kimono-ACC wear-TEI-NPST TOKORO COP-NPST
'She's in the kimono right now.'

We leave a full analysis of these cases to a future occasion.

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Parentheticality, assertion strength, and discourse[1]

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Abstract. Sentences with so-called SLIFTING PARENTHETICALS (e.g. *The dean, Jill said, flirted with the secretary*; Ross 1973) grammaticalize an intriguing interaction between speech act function and conventional meaning, one that is not found in regular embedding constructions (e.g. *Jill said that the dean flirted with the secretary*). In such sentences, the main clause is independently asserted and at the same time is interpreted in the scope of the parenthetical, which typically serves an evidential function. The discourse effect of this pragmasemantic setup is that slifting parentheticals modulate the strength with which the main part of the sentence is asserted (Urmson 1952, Asher 2000, Rooryck 2001, Davis et al. 2007, Simons 2007, Maier and Bary 2015). Building on Davis et al. (2007), this paper proposes a probabilistic discourse model that captures the role of parentheticality as a language tool for qualifying speaker's commitments. The model also derives two empirical properties that set apart slifting parentheticals from regular embedding constructions, i.e. (i) the fact that slifting parentheticals invariably express upward entailing operators and (ii) the fact that they usually do not occur in subordinate clauses.

Keywords: parentheticals, evidence, assertion, polarity, embedding, probability.

1. Introduction

The interpretational properties of sentences with SLIFTING PARENTHETICALS (Ross 1973) are perhaps best illustrated by direct comparison to regular embedding constructions. Consider the minimal pair of sentences below.

(1) The dean, Jill said, flirted with the secretary.

(2) Jill said that the dean flirted with the secretary.

The slifting sentence in (1) is largely synonymous with its embedding counterpart in (2). In most contexts, uttering either sentence would imply, in some weak sense, that the dean flirted with the secretary and attribute this information to Jill. The strength of such weak implications is contingent on the additional information provided, including the lexical properties of the attitude predicate (e.g. *say* leads to a weaker claim than *discover*) and the quality of the source (e.g. Jill might be a more trustworthy source than Marissa when it comes to the dean's flirtations). We see that parentheticals as well as embedding constructions can both be used to express claims with a varying degree of strength.

However, slifting sentences exhibit a range of properties that set them apart from regular embedding constructions. Here I discuss two such differences. The first difference concerns the

[1] I would like to thank Dan Lassiter, Roger Schwarzschild, Peter Sutton, and the audiences at *Backgrounded Reports* 2016 and *Sinn und Bedeutung* 21. For judgments, I am indebted to Kurt Erbach, Jeremy Perkins, and Peter Sutton. All mistakes are my own.

observation that the former constructions obey certain polarity restrictions. Jackendoff (1972), Ross (1973), Hooper (1975), and Maier and Bary (2015) already notice that slifting parentheticals usually cannot host negation. Generalizing this observation, we could say that slifting parentheticals may create upward entailing but not downward entailing environments. This is illustrated in (3), where *I think* expresses an upward entailing operator and *I doubt* expresses a downward entailing operator. In contrast to parentheticals, the matrix clause of embedding constructions is not sensitive to the direction of the polarity it creates (4).

(3) Snowden is a Russian spy, $\left\{\begin{array}{c}\text{I think}\\ \text{\#I doubt}\end{array}\right\}$.

(4) $\left\{\begin{array}{c}\text{I think}\\ \text{I doubt}\end{array}\right\}$ Snowden is a Russian spy.

Second, slifting parentheticals have a more limited syntactic distribution than embedding clauses. The former do not easily modify subordinate clauses and thus do not appear in the scope of a propositional operator (5). This is in contrast to the latter constructions, which can easily be further embedded (6).

(5) #Selena thinks that Justin, the vocal coach said, is a talented singer.

(6) Selena thinks the vocal coach said that Justin is a talented singer.

The upshot of this preview of properties is that any good semantic theory of slifting sentences needs to explain why such sentences give rise to claims comparable in strength to the claims expressed by embedding constructions. At the same time, the theory should be able to derive the unique properties of slifting sentences that distinguish them from embedding constructions.

Section 2 states the main assumption of the paper. In Section 3, I show how graded claims can be modeled by using standard tools from probabilistic reasoning. Section 4 discusses the polarity and scopal properties of slifting parentheticals. Section 5 is the conclusion.

2. One sentence, two assertions

The main claim of this paper is that slifting sentences stand apart from regular embedding constructions because of a single basic fact. Following similar claims in previous literature, I assume that slifting sentences make two semantic contributions as part of their conventional meaning (cf. Urmson 1952, Hooper 1975, Bach 1999, Asher 2000, Potts 2005, Simons 2007, Maier and Bary 2015, Hunter 2016). More specifically, I assume that the slifted clause (the non-parenthetical part of the sentence) invariably encodes the main assertion while the sentence as a whole expresses secondary, typically evidential information. Hooper and Simons put this idea succinctly:

> "[...] the effect of complement preposing is to make the complement proposition the main assertion of the sentence while reducing the original main clause to parenthetical or secondary status. [...] there are two assertions, or two claims to

> truth. The first one, from the preposed complement, is given more importance in this construction, and the parenthetical assertion is clearly subordinated."
> (Hooper 1975: 95)

> "From a discourse or usage point of view, it seems quite clear that the main point of an utterance of a slifted sentence will be the content of the slifted (i.e. non-parenthetical) clause, with the syntactically parenthetical clause serving a parenthetical function." (Simons 2007: 1039)

This assumption can be summarized as follows.

(7) DOUBLE ASSERTION HYPOTHESIS
A slifting sentence makes two assertions. The main assertion is expressed by the slifted clause and the parenthetical asserts secondary information.

This hypothesis implies that the sentence in (8), repeated from (1), asserts both (8a) and (8b).

(8) The dean, Jill said, flirted with the secretary.
a. The dean flirted with the secretary. (MAIN ASSERTION)
b. Jill said that the dean flirted with the secretary. (PARENTHETICAL ASSERTION)

I argue that the Double Assertion Hypothesis can explain the potentially weakening effect of slifting parentheticals on the main claim and derive the ways in which such sentences differ from regular embedding constructions. While the latter constructions can be used to trigger weak implications as well, these implications need not be written into the semantics and can be derived through reasoning.

It is important to emphasize that the privileged semantic role of slifted clauses correlates with their apparent syntactic status as main clauses. Grimshaw (2011) presents a battery of arguments in support of the claim that English slifted clauses are indistinguishable in form from main clauses. She shows that, unlike subordinate clauses, slifted clauses cannot be non-finite (9), cannot be headed by a complementizer (10), require subject–auxiliary inversion when the parenthetical includes an interrogative predicate (11), and generally block quantifier binding from the parenthetical (12). The following data are adapted from Grimshaw (2011: 4–6).

(9) a. *To leave, I promised them.
b. I promised them to leave.

(10) a. *That it was raining hard, they thought.
b. They thought that it was raining hard.

(11) a. Had she made a mistake, he wondered.
b. *He wondered (whether) had she made a mistake.

(12) a. ??She$_i$ liked the film, every girl$_i$ said.
b. Every girl$_i$ said that she$_i$ liked the film.

This argues for a main clause analysis of slifted clauses (Jackendoff 1972) over one which views them as raised or "s(entence-)lifted" complements (Ross 1973). While the precise syntactic analysis of slifting sentences is not the focus of this paper, given the weight of the empirical evidence, I will assume that slifted clauses are main clauses and treat slifting parentheticals as adjuncts.

3. Modulating assertion strength

We have already seen that the strength with which a clause is implied can be qualified by parenthetical modification or through semantic embedding. For example, the unqualified claim in (13) can be weakened as in (13a) or (13b).

(13) Jack is married to a nurse.
a. Jack, Emmy said, is married to a nurse.
b. Emmy said that Jack is married to a nurse.

There are two simple yet important observations to be made about (13a)–(13b). The first observation is that the degree to which (13) is implied is modulated by the quality of the evidence stated in the parenthetical or the matrix clause. For example, changing *Emmy said* to *Emmy discovered*, *Emmy might have said*, or *Everyone claims* may result in a stronger or a weaker claim. The second observation is that if the context is held constant, the relative strength with which (13) is implied by each sentence is roughly the same. If we schematically represent slifting sentences as C,E and embedding constructions as $E(C)$, where C and E are mnemonics for "claim" and "evidence" (respectively), these two empirical observations can be summarized as follows.

(14) If C,E and $E(C)$ are uttered in the same context, then:
a. STRENGTH DEPENDENCE: The implication strength of C is contingent on E in both C,E and $E(C)$.
b. STRENGTH SIMILARITY: C is implied with approximately the same strength by C,E and $E(C)$.

I take it that Strength Dependence is quite uncontroversial. One piece of evidence for Strength Similarity is the fact that the main claim put forward by slifting or embedding sentences can be doubted or denied by the speaker with a comparable degree of ease.

(15) Jack, Emmy said, is married to a nurse, but $\left\{\begin{array}{c}\text{I doubt he really is}\\ \text{I'm sure he isn't}\end{array}\right\}$.

(16) Emmy said that Jack is married to a nurse, but $\left\{\begin{array}{c}\text{I doubt he really is}\\ \text{I'm sure he isn't}\end{array}\right\}$.

There appears to be some variation in judgment regarding the strength of slifted clauses, though.

Jackendoff (1972), Asher (2000), Murray (2014), and Hunter (2016) claim that slifted propositions cannot always be denied, even when the respective embedded proposition can.[2]

(17) a. Myrtle will come tomorrow, Margaret believes, (#but she actually came yesterday).
b. Margaret believes that Myrtle will come tomorrow, but she actually came yesterday. (examples from Jackendoff 1972: 97)

(18) a. #John, Mary assures us, can be trusted, but I don't trust him.
b. Mary assures us that John can be trusted, but I don't trust him.
(examples from Asher 2000: 36)

If these data are real, one possible explanation is that the contrast in judgment may have to do with the central discourse status of slifted clauses (see Section 4.2). However, I discovered that English speakers tend to accept (17a) and (18a). Moreover, all speakers I consulted find such sentences felicitous if a weaker follow-up (e.g. *but I seriously doubt it*) is used, such that the possibility that the slifted clause is true is left open. I will then assume that slifted clauses imply commitments that more or less match the commitments implied by the respective embedded propositions.

How can we model weak assertions? Davis et al. (2007) hypothesize that there are two major language strategies for qualifying a claim. The first strategy involves semantic embedding under an appropriate modal operator, which weakens the original claim by manipulating its truth conditions. This is the strategy illustrated by embedding constructions. Under the second strategy, first suggested in Lewis (1976), the speaker specifies the source of information and may weaken the original claim by lowering the quality threshold for asserting it.[3] Since slifting parentheticals provide evidential support for the main claim, slifting sentences arguably lexicalize this latter strategy (see also Simons 2007, Murray 2014, Hunter 2016). To illustrate the evidential strategy, Davis et al. (2007: 81) outline the following three-step procedure (here slightly adapted).

(19) If a parenthetical sentence C,E is uttered by an agent a and in a context c, then:
i. a assumes a commitment to having E-type evidence for C,
ii. the quality threshold θ^c is readjusted to the reliability of E, and then
iii. a asserts C against θ^c.

One intuitive way of fleshing out Davis et al.'s idea is to assume that propositions enter the common ground as indexed by quality thresholds, which impose a lower bound on their certainty level. The threshold against which a slifted clause C is asserted will depend not only on the context but also on the reliability of the evidence E provided by the slifting parenthetical. This threshold could then be less than the default for the given context. In contrast to parentheticals,

[2] For reasons of uniformity and in order to do justice to the proposal, in borrowed examples I will often substitute ungrammaticality marking (*) with pragmatic unacceptability marking (#).

[3] Davis et al. (2007) call these the MODAL and the EVIDENTIAL strategy, respectively. I find this terminology confusing in both directions. On one hand, slifting parentheticals contain modals as main predicates; on the other hand, modal verbs often contribute evidential meanings (von Fintel and Gillies 2010, Lassiter 2016).

an embedding sentence $E(C)$ will always be evaluated against the unmodified threshold. If C is weakened, this is because it is interpreted in the semantic scope of E, not because it is weakly asserted.

As an illustration, consider a context with a quality threshold of 0.9 and one in which the likelihood of Emmy's words being true is 0.7. If *Jack, Emmy said, is married to a nurse* is uttered, we will add to the common ground both the proposition that Emmy said Jack is married to a nurse (indexed by 0.9) and the proposition that Jack is married to a nurse (indexed by 0.7). In turn, if *Emmy said Jack is married to a nurse* is uttered, only the former proposition will be added to the common ground, and it will be indexed by 0.9.

This way of looking at things does not yet derive Strength Dependence or Strength Similarity. We still need to explain why embedded clauses, although not asserted, are implied with a comparable degree of confidence to slifted clauses, and why in both cases this degree depends on the quality of the evidence. Both of these constraints can be accounted for if we assume that contexts are associated with PROBABILITY MEASURES.[4] Probability measures are functions μ from propositions (sets of possible worlds) to real numbers between 0 and 1 such that (i) μ maps the universal set of worlds to 1 and (ii) μ maps the union of any two disjoint propositions p and q to the sum of $\mu(p)$ and $\mu(q)$. Instead of representing common grounds as sets of indexed propositions, i.e. as objects of the form $CG = \{\langle p_1, \theta_1 \rangle, \ldots, \langle p_n, \theta_n \rangle\}$, we can view them as effectively specifying a probability measure, i.e. a function μ such that $\mu(p_1) = \theta_1, \ldots,$ $\mu(p_n) = \theta_n$.

We now want to model the intuition that discourse-new information may modify the likelihood of discourse-old information. Assume that we are given a prior probability for p and just learned that q. How should we update the probability of p in light of the new evidence q? One could employ the mechanism of CONDITIONALIZATION, which involves redistributing probability weights after new information is obtained. In its simple form, the probability measure μ conditionalized on the proposition q is defined as follows, for any proposition p.

(20) SIMPLE CONDITIONALIZATION

$$\mu_q(p) = \frac{\mu(p \cap q)}{\mu(q)}, \text{ where } \mu(q) \neq 0$$

However, simple conditionalization is too rigid for our threshold-based discourse model. It presumes that the newly obtained information q is certain and tells us how much of its probability weight is assigned to $p \cap q$. But what if q itself is uncertain, e.g. asserted against a threshold of $\theta = 0.9$? Work in philosophy and cognitive science has adopted a slightly more complicated mechanism, called JEFFREY CONDITIONALIZATION (Jeffrey 1990). While not previously used in formal semantics to the best of my knowledge, it gives us what we want because it is expressed in terms of simple conditionalization but also factors in the uncertainty of the evidence.[5]

[4]Probability measures have been widely studied and have well-understood properties. Less-familiar tools for modeling uncertainty include Dempster–Shafer belief functions, possibility measures, etc. (see Halpern 2003 for an overview).

[5]Jeffrey himself called this generalized form of conditionalization "probability kinematics". Notice that this

(21) JEFFREY CONDITIONALIZATION (Jeffrey 1990)
$\mu_{\langle q,\theta\rangle}(p) = \theta\,\mu_q(p) + (1-\theta)\,\mu_{\neg q}(p)$, where $0 < \mu(q) < 1$

Here the evidence is made sensitive to its likelihood: $\mu_{\langle q,\theta\rangle}(p)$ stands for the probability of p, given that the likelihood of q is θ. It is easy to see that when the evidence is certain, i.e. $\theta = 1$, Jeffrey conditionalization reduces to its simple relative. That is, $\mu_{\langle q,1\rangle} = \mu_q$, for any q. The following example illustrates the usefulness of Jeffrey conditionalization in accumulating new evidence.

Example Let p stand for the proposition *It is raining*, q stand for the proposition *Mary said it is raining*, and $\mu(p) = 0.5$, $\mu(q) = 0.5$, $\mu_q(p) = 0.7$. That is, we are completely ignorant as to whether p or q are true but we know that learning q would substantially increase the likelihood of p, e.g. because Mary is a fairly reliable source of weather information. What is the posterior probability of p if q is uttered at a 0.9 quality threshold?

- By Bayes' rule, the prior probability of q given p is: $\mu_p(q) = \dfrac{\mu_q(p)\,\mu(q)}{\mu(p)} = \dfrac{0.7 \times 0.5}{0.5} = 0.7$.
- By the complement rule, the prior probability of $\neg q$ is: $\mu(\neg q) = 1 - \mu(q) = 1 - 0.5 = 0.5$.
- By Bayes' rule and the complement rule: $\mu_{\neg q}(p) = \dfrac{\mu_p(\neg q)\,\mu(p)}{\mu(\neg q)} = \dfrac{(1-\mu_p(q))\,\mu(p)}{1-\mu(q)} = \dfrac{(1-0.7) \times 0.5}{1-0.5} = 0.3$.
- By the Jeffrey conditionalization rule and given that q is uttered at a threshold of 0.9, the posterior probability of p is: $\mu_{\langle q,0.9\rangle}(p) = 0.9\,\mu_q(p) + (1-0.9)\,\mu_{\neg q}(p) = 0.9 \times 0.7 + 0.1 \times 0.3 = 0.66$.

The probability of rain thus increases from 50% to 66%. This is lower than the 70% produced by simple conditionalization, since the latter rule does not take into account that we are only 90% certain that Mary said it was raining. **End of example**

The effect of slifting and embedding sentences on the probability measure of the context can now be rendered as follows.

(22) Slifting sentences C, E: $\mu \xrightarrow{\langle [\![E(C)]\!],\theta\rangle} \mu' \xrightarrow{\langle [\![C]\!],\mu'([\![C]\!])\rangle} \mu''$

(23) Embedding sentences $E(C)$: $\mu \xrightarrow{\langle [\![E(C)]\!],\theta\rangle} \mu'$

rule falls out from a few basic facts of probability theory. Proof:

$$\begin{array}{llll} \mu(p) & = & \mu(p \cap q) + \mu(p \cap \neg q) & \text{total probability law} \\ & = & \mu(q)\,\mu_q(p) + \mu(\neg q)\,\mu_{\neg q}(p) & \text{conditional probability} \\ & = & \mu(q)\,\mu_q(p) + (1-\mu(q))\,\mu_{\neg q}(p) & \text{complement} \\ & = & \theta\,\mu_q(p) + (1-\theta)\,\mu_{\neg q}(p) & \theta = \mu(q) \qquad \text{QED} \end{array}$$

If a slifting sentence C, E is uttered, the probability measure is first conditionalized on $\langle [\![E(C)]\!], \theta \rangle$ and then conditionalized on $\langle [\![C]\!], \mu'([\![C]\!]) \rangle$ (22). The strength of the evidential proposition $[\![E(C)]\!]$ is then the threshold value θ and the strength of the main proposition $[\![C]\!]$ is its prior probability μ conditionalized on the evidential proposition at θ. In turn, if an embedding sentence $E(C)$ is uttered, the probability measure is conditionalized on $\langle [\![E(C)]\!], \theta \rangle$ alone (23). Even though in this latter case the embedded clause is not asserted, speech participants may employ probabilistic reasoning to infer that the likelihood of C, given that $E(C)$ was asserted against θ, is $\mu_{\langle [\![E(C)]\!], \theta \rangle}([\![C]\!])$. This story accounts for both Strength Dependence and Strength Similarity: the strength of C depends on the strength and relevance of $E(C)$ in both cases. Slifting sentences and embedding sentences are then predicted to play a similar role when it comes to what inferences speakers may draw from them. They only differ in that the former assert (perhaps weakly) the slifted clause while the latter do not assert the embedded clause.

4. The uniqueness of slifting parentheticals

The analysis of varying assertion strength proposed in the previous section does not directly predict any substantial interpretational differences between slifting and embedding sentences. However, as already mentioned in the Introduction, the two constructions differ in polarity and distribution. This section discusses these differences in depth and argues that they both are rooted in the Double Assertion Hypothesis and general principles of discourse organization.

4.1. Polarity restrictions

Other things being equal, one might expect that slifting parentheticals can have the same grammatical make-up as matrix clauses. For example, the fragment *Jill said* can be used parenthetically and it can also serve as a matrix clause. However, Jackendoff (1972), Ross (1973), Hooper (1975), and Maier and Bary (2015) notice that, unlike matrix clauses, slifting parentheticals need to make a "positive" or "affirmative" import. At least initially, it appears that slifting parentheticals cannot contain negation or lexically negative predicates.

(24) John is, $\left\{ \begin{array}{c} \text{I think} \\ \text{\#I don't think} \\ \text{\#I doubt} \end{array} \right\}$, a fink. (Jackendoff 1972: 97)

(25) $\left\{ \begin{array}{c} \text{I think} \\ \text{I don't think} \\ \text{I doubt} \end{array} \right\}$ John is a fink.

The same authors also observe that there is no syntactic ban on slifting parentheticals hosting negation or negative predicates. If a slift contains a lexically negative verb (like *doubt* or *deny*) that is negated, the sentence becomes acceptable.

(26) John is, I don't doubt, a fink. (Jackendoff 1972: 97)

(27) Mushrooms are great on diets, I don't doubt. (Ross 1973: 155)

(28) It's a long shot, I don't deny. (Hooper 1975: 107)

The positive/affirmative import generalization must then be a semantic one and it must constrain the entire slifting parenthetical, not just its main predicate. I propose that it should be stated in terms of monotonicity.[6]

The monotonicity properties of operators have been widely discussed in the literature on polarity items and elsewhere. The two crucial notions of upward and downward entailingness are standardly defined as follows (e.g. Ladusaw 1980).

(29) a. An operator O is UPWARD ENTAILING iff for any propositions p and q, if $p \subseteq q$ then $O(p) \subseteq O(q)$.
b. An operator O is DOWNWARD ENTAILING iff for any propositions p and q, if $p \subseteq q$ then $O(q) \subseteq O(p)$.

Asher (1987) develops a semantic typology of a wide range of propositional attitude predicates. He proposes that verbs like *say*, *think*, *believe* are upward entailing while verbs like *deny* or *doubt* are downward entailing.[7] Indeed, if Jimmy believes I own a Porsche (and he also knows that Porsches are cars), then he must believe that I own a car. In turn, if Jimmy doubts I own a car (and knows that Porsches are cars), then he must doubt that I own a Porsche as well.

The polarity generalization about slifting parentheticals can now be stated as follows.

(30) UPWARD MONOTONICITY
A slifting sentence C, E can be felicitously uttered only if E expresses an upward entailing operator.

Assuming that no operator can be both upward and downward entailing, Upward Monotonicity correctly bans slifts from creating downward entailing environments. It also rules out slifts that express non-monotone operators, i.e. operators that are neither downward nor upward entailing. The verb *lie* is one example of a non-monotone propositional operator; e.g. there is no entailment relation between (31a) and (31b).[8] Upward Monotonicity then correctly predicts that the sentences in (32), which host non-monotone slifts, are not acceptable.

(31) a. Jeremy lied that he resides in Vancouver.
b. Jeremy lied that he resides in Canada.

[6] There appear to be further restrictions on what can go into slifting predicates that go beyond polarity and that are not addressed in this paper. See Ross (1973), Hooper (1975), and Haddican et al. (2014) for discussion.

[7] I will sometimes loosely talk of lexical items themselves as being upward or downward entailing. What is meant is that the operators that those items denote have the claimed monotonicity.

[8] The reason *lie* is non-monotone might be that *a lied that p* implies both *a said p* and *not-p*. Since *a* said is upward entailing while not is downward entailing, the combined effect is that of non-monotonicity. I am indebted to Emar Maier for the suggestion that *lie* expresses a non-monotone operator.

(32) a. #Paul had never known his mother, he lied.
b. #The CEO, his girlfriend lied, is a true gentleman.

There are two cases of seeming violations of Upward Monotonicity that deserve further mentioning. The first case involves situations when the speaker echoes a previous utterance and disagrees with it by using a segment that resembles a negated slifting parenthetical. This use is illustrated in (33), and can be read as *Mushrooms are great on diets? I don't think so*. The second case involves what looks like a negated slifting parenthetical attached to a negated main clause (34). The apparent function of such parentheticals is to qualify the categorical denial of a claim expressed by the first part of the sentence.

(33) Mushrooms are great on diets, I don't think so.

(34) Matt doesn't like phonology, I don't think.

It is fairly clear that (33) is not a slifting sentence at all. This is because the argument slot in the second segment is filled by a *so*-anaphor and without it the sentence becomes unacceptable. Genuine slifts do not allow *so*-insertion (cf. **The dean, Jill said so, flirted with the secretary*). While examples as in (34) do exhibit the grammatical form of slifting constructions, they turn out to have a very limited distribution and quirky interpretational properties. Ross (1973) and Hooper (1975) observe that in such examples the negation in the parenthetical is licensed by a negation in the main clause. Just any downward entailing operator in the main clause cannot support a negated slift (cf. **Few people like phonology, I don't think*) and just any downward entailing slift cannot be licensed by a negated main clause (cf. **Matt doesn't like phonology, I doubt*). In addition, the putative parenthetical may modify a non-clausal argument (cf. *Matt doesn't like phonology, I don't think he does*) and has to appear at the end of the sentence (cf. **Matt, I don't think, doesn't like phonology*). Ross (1973) also notices that such doubly-negated sentences are restricted to Neg-Raising predicates (cf. *Matt doesn't like phonology, I don't think* / **I don't fear*). Most importantly, as noted in Huddleston and Pullum (2002: 845), the negation in the slift is semantically vacuous, and (34) is synonymous with *Matt doesn't like phonology, I think*. I will then tentatively assume that such constructions illustrate some sort of negative concord and are actually upward entailing. If so, the data in (33)–(34) do not challenge the Upward Monotonicity restriction.

Where does Upward Monotonicity come from? Two explanations have been suggested in the literature, although none of them seems able to explain the full range of data. One idea is that this generalization falls out from the relative strength with which a main clause is asserted. Hooper (1975), Scheffler (2009), and Hunter (2016) propose that, roughly, upward entailing slifts imply the main clause with a sufficiently high level of confidence while downward entailing slifts do not. Assuming that τ is the minimal threshold that any assertion (whether weak or strong) in the given context should meet, we could then propose the following constraint.

(35) ASSERTION STRENGTH
A slifting sentence C, E can be felicitously uttered only if $\mu_{\langle [\![E(C)]\!], \theta \rangle}([\![C]\!]) \geq \tau$.

However, this constraint immediately runs into empirical difficulties. A segment like *it seems* entails its propositional argument in a fairly weak sense but can serve as a parenthetical (cf. *Noah majored in psychology, it seems*). In contrast, a segment like *he regrets* contains a factive predicate that presupposes the truth of its propositional argument, yet it is unacceptable as a parenthetical (cf. #*Noah majored in psychology, he regrets*). Assertion Strength leaves these facts unexplained.

A related idea is that Upward Monotonicity is tied to the evidential role of slifting parentheticals. Haddican et al. (2014) and Maier and Bary (2015) suggest that upward entailing operators provide a good source of evidence while downward entailing operators do not. We could then require that parentheticals raise the likelihood of the main sentence being true.

(36) EVIDENTIAL SUPPORT
A slifting sentence C, E can be felicitously uttered only if $\mu_{\langle [\![E(C)]\!], \theta \rangle}([\![C]\!]) > \mu([\![C]\!])$.

The main challenge for this constraint is negative evidence. Evidential Support predicts that in the given context (37a) is infelicitous, and it would not let us expect that there is anything wrong with (37b). Indeed, if Putin rarely tells the truth, what he says is likely to be false and what he denies is likely to be true. The attested data are the exact opposite of what is predicted.

(37) *Putin is a rogue leader who typically makes false claims in order to deceive his enemies.*
a. There are Russian troops in Ukraine, Putin said.
b. #There are Russian troops in Ukraine, Putin denied.

I propose that Upward Monotonicity has less to do with the semantics of slifting parentheticals and more to do with the fact that slifted clauses do double duty: they are independently asserted (albeit perhaps weakly) and they serve as arguments to slifting parentheticals, as stated by the Double Assertion Hypothesis. Slifting parentheticals are upward entailing because slifted clauses in particular and main clauses in general act like POSITIVE POLARITY ITEMS (PPIs). For example, (38) hosts a main clause interpreted under an upward entailing (UE) operator and the sentence is acceptable; (39) hosts a main clause interpreted under a downward entailing (DE) operator and the sentence is unacceptable.

(38) [Snowden is a Russian spy]$_{PPI}$, [Mary thinks]$_{UE}$.

(39) #[Snowden is a Russian spy]$_{PPI}$, [Mary doubts]$_{DE}$.

The positive polarity status of slifted clauses may be taken to follow from fact that assertions should allow speech participants to draw entailments, which are weaker inferences. In other words, asserted sentences need to be closed under their entailments, as stated by the following constraint.

(40) ENTAILMENT CLOSURE
A sentence S can be felicitously uttered only if S and all of its entailments meet the quality threshold of the context.

This type of general constraint may appear to be of little value when it comes to single assertions, because entailments are less specific than what is said and Entailment Closure will always be met. But some constraint along those lines becomes important in slifting sentences, where the slifted clause serves an argument of the parenthetical yet it is also independently asserted, as per the Double Assertion Hypothesis. It is then plausible to require that parenthetical assertions are closed under the entailments of the slifted clause.

(41) PARENTHETICAL ENTAILMENT CLOSURE
A slifting sentence C,E can be felicitously uttered only if, for any entailment C' of C, $E(C')$ meets the quality threshold whenever $E(C)$ does.

This constraint can be further elucidated by drawing attention to the fact that the two assertions C and $E(C)$ associated with a slifting sentence C,E are proportional with respect to their informativity. When E is upward entailing, the strength of $E(C)$ is directly proportional to the strength of C and any weakening of C makes $E(C)$ weaker, i.e. truth is always preserved. If, however, E is downward entailing, the strength of $E(C)$ is inversely proportional to the strength of C. In this case, a weaker C makes $E(C)$ stronger, and truth need not be preserved. In other words, only upward entailing slifting parentheticals will obey Parenthetical Entailment Closure.

To illustrate, notice that speakers may draw all sorts of entailments from the main clause in (39), including that Snowden is a spy. However, this would violate Parenthetical Entailment Closure, because the parenthetical assertion does not guarantee that Mary doubts Snowden is a spy; it only guarantees that Mary doubts Snowden is a *Russian* spy. No such problem arises in (38), because here the truth of the parenthetical assertion is preserved for all entailments of the main clause. In particular, if Mary thinks that Snowden is a Russian spy, it follows that she also thinks Snowden is a spy.

Before closing this section, one should point out that the positive polarity status of main clauses is visible from data that go beyond slifting sentences, thereby strengthening the case for an entailment closure constraint of the form proposed above. As Ross (1973), Szabolcsi and Zwarts (1993), and Potts (2002) notice, an upward monotonicity restriction is operational in *as*-parentheticals as well.

(42) John is our hero, $\left\{ \begin{array}{c} \text{as you know} \\ \text{\#as no one knows} \end{array} \right\}$. (after Szabolcsi and Zwarts 1993: 246)

Verb second embedding in German is restricted in the same way. Although main clauses are verb second and embedded clauses are verb final, German draws a grammatical distinction between regular embedding of *dass*/'that' complements with a verb final syntax and embedding of verb second clauses. Importantly, Scheffler (2009) points out that while attitude verbs of any monotonicity can occur in regular embedding constructions, verb second embedding is restricted to upward entailing attitudes.

(43) a. Peter glaubt, Maria ist schwanger.
Peter believes Maria is pregnant
'Peter believes that Maria is pregnant.'
b. #Maria bereut, sie ist nach Berlin gezogen.
Maria regrets she is to Berlin moved (Scheffler 2009: 184)

Finally, certain speaker-oriented adverbs exhibit similar behavior. Jackendoff (1972) and Bellert (1977) mention the fact that discourse adverbs do not have negative counterparts.

(44) a. $\left\{\begin{array}{c}\text{Truthfully}\\ \text{Honestly}\\ \text{Sincerely}\end{array}\right\}$, I can't tell you the answer.
b. $\left\{\begin{array}{c}\text{\#Falsely}\\ \text{\#Dishonestly}\\ \text{\#Insincerely}\end{array}\right\}$, I can't tell you the answer. (Jackendoff 1972: 99)

Apparently, these polarity restrictions have a common source. I suggest that they are all based on a mechanism similar to the one proposed for English slifting sentences.

4.2. Main clause modifiers

A second difference between slifting and embedding sentences concerns their embeddability. It has been noticed that slifting sentences typically modify main clauses and cannot appear in subordinate clauses (Ross 1973, Rooryck 2001). Embedding constructions do not have this property and can readily be further embedded.

(45) a. #Martin now realizes that Sheila is, I had claimed, a luscious yummy. (Ross 1973: 152)
b. #Selena thinks that Justin, the vocal coach said, is a talented singer.

(46) a. Martin now realizes that I had claimed Sheila is a luscious yummy.
b. Selena thinks that the vocal coach said Justin is a talented singer.

The data in (45) also show that the scope of slifting parentheticals is clause-bounded, i.e. that slifts obligatorily modify their host clause. If that were not the case, (45a) and (45b) would be acceptable under a reading whereby the parenthetical takes scope over the entire sentence.

I propose that the main clause restriction on slifting parentheticals once again follows from the Double Assertion Hypothesis. Recall that this hypothesis states that slifted clauses play a primary discourse role while the parenthetical component serves a subsidiary function. An empirical reflex of this contrast in pragmatic status is the fact that a slifted clause but not the entire parenthetical sentence can resolve a question, as demonstrated below.

(47) Q: Why is Fred not here?
A: He has quit his job, the secretary told me.

(48) Q: What happened next?
A: #There is life on Mars, she announced.

In a similar vein, Asher (2000: 33) gives the following example.

(49) A: The party, Mary assures us, is over.
B: #Does she?

How can we flesh out the non-central discourse status of slifting parentheticals? Asher assumes that the parenthetical component of a slifting sentence is connected to the main clause through an Evidence discourse relation. But evidentiality alone would not explain why (48) and (49) are unacceptable, since in principle evidential information can answer questions (cf. *A: Lena is dating someone. B: How do you know? A: She always leaves work early.*). The subordinate status of slifting parentheticals must then come from somewhere else.

I propose that what is wrong with (48)–(49) is not that the parenthetical assertion cannot resolve a question but rather that the main assertion must but does not do so. I assume, quite plausibly, that main clauses are conventionally marked as AT-ISSUE, where the property of at-issueness is understood as relevance to the question under discussion, as argued in Simons et al. (2010) and much subsequent work. Arguably, this is the reason why the discourses below are degraded.

(50) A: Who was Louise with last night?
B: Henry $\left\{\begin{array}{c}\text{(?)hopes}\\ \text{?wishes}\\ \text{?dreamt}\end{array}\right\}$ that she was with Bill. (Simons 2007: 1036)

(51) Q: What is Peter's favorite color?
A: ?Peter, whose favorite color is blue, never wears white shirts.

The following constraint requires that main clauses pick out one of the alternatives introduced by the question under discussion.

(52) AT-ISSUENESS
A (declarative) main clause C can be felicitously uttered in a context with a question under discussion Q only if $[\![C]\!] \in Q$.

Given that slifted clauses are main clauses, At-Issueness entails that a slifting sentence C, E can be felicitously uttered only if $[\![C]\!] \in Q$, where Q is the question under discussion in the given context. One way to read this is that slifting parentheticals attach to clauses that are obligatorily at-issue, i.e. main clauses. It is then to be expected that such parentheticals do not occur in syntactically subordinate positions. Since embedded clauses need not be marked for discourse status, embedding predicates can freely be further embedded.

In the remaining part of this section, I address one type of exception to the non-embeddability of slifting parentheticals. The following sentence is acceptable and the parenthetical seems to take narrow scope with respect to the matrix verb (see also Ross 1973).

(53) Sarah said that Will, she thinks, has strong qualifications.

One possible reaction would be to say that embedded clauses too can take on at-issue status.[9] However, this begs the question of why slifting parentheticals do not embed on a regular basis. What I would like to suggest is that examples as these are likely based on some sort of an agreement mechanism whereby the slift restates what is already expressed by the matrix clause. In support of this view, notice that (53) deteriorates if the slift presents a fresh perspective by introducing a different attitude holder (54). Also, such examples seem to require predicates that can describe the same attitude, e.g. *say* and *think*. (53) becomes unacceptable if the matrix and the slifting predicates do not line up semantically (55).

(54) ?Sarah said that Will, the committee thinks, has strong qualifications.

(55) #Sarah imagined that Will, she thinks, has strong qualifications.

I leave the precise analysis of such examples to further research, here merely noting their special properties.

5. Conclusion

This paper investigated the semantic properties of sentences with slifting parentheticals. The main claim was that such constructions function as a means of modulating assertion strength. I proposed a probabilistic account whereby the assertion strength of the slifted clause is derived from the background discourse information conditionalized on the evidence described by the parenthetical component. The account was shown to capture the intuition that the implication strength of slifted clauses varies depending on the quality and certainty of the evidence. Importantly, slifting sentences were not reduced to embedding constructions and their unique properties were preserved. In particular, the proposal was able to explain why slifting parentheticals express upward entailing operators and why they typically modify main clauses. The paper argued that those properties follow from the double assertion nature of slifting sentences and general principles of discourse management.

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[9] Cf. so-called DISCOURSE PAENTHETICAL uses of matrix clauses (Urmson 1952, Simons 2007, Hunter 2016).

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Simple *even* hypothesis: NPIs and differences in question bias[1]

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Abstract. The *even*-based approach to NPI licensing arose as a competitor to the traditional idea that NPIs are licensed by some monotone environments. The approach itself equates NPIs with *even* + existential quantification. As such, distributional differences between NPIs and the expression *even ONE* are undesirable. There are, however, a small number of known differences: (i) They behave differently in the restrictor of a universal quantifier, and (ii) questions containing *even ONE* are negatively biased, whereas questions with an NPI are not. Under our proposal, we decompose weak EVEN into two focus particles. One is identical to the original EVEN, whereas the other particle has a directly opposite scalar presupposition and an additional presupposition of exclusivity. In doing so, we can derive both problematic cases for the *even*-based approach in a straightforward fashion.

Keywords: negative polarity item, NPI, *even*, question bias, local accommodation, projection

1. Introduction

Accounting for the entire distribution of negative polarity items (NPI) has been an ongoing issue for linguists for nigh a century: Formally starting with the work of Jespersen (1917) and Klima (1964), we have yet to discover a model that is capable of accounting for the entire set of known empirical data. Traditionally, NPIs are analysed as being licensed by certain monotone environments (cf. Fauconnier, 1975; Ladusaw, 1979): Namely, NPIs are generally considered to be licensed by (Strawson) downward-monotone environments.

However, alternative models to NPI licensing have recently been on the rise (e.g. Krifka, 1995; Chierchia, 2013: and others). One of the major alternative NPI models would be the *even*-based approach to NPI licensing (cf. Lee and Horn, 1994; Lahiri, 1998; Crnič, 2011a). Essentially, this approach states that any NPI is covertly licensed by the focus particle *even* at logical form (LF). The NPI itself is equivalent to weak existential quantification (i.e. *any* would be equivalent to *even ONE*). With most of the objections to this approach (cf. Heim, 1984) having been defused by Crnič (2014a, b), only a few major obstacles remain: One of them is the difference in polar question bias between questions containing the expression *even ONE* (hereafter referred to as *even*-questions) and questions containing the unstressed NPI *any* (hereafter referred to as NPI-questions). Whereas the former type appears to be negatively biased (i.e. rhetorical by nature), the latter question type corresponds to normal information-seeking questions. A dissimilarity that is not predicted by equating both expressions, as is done in the *even*-based approach. Another difference in distribution is that *even ONE* and *any* behave differently within the restrictor of a universal quantifier.

This paper explores how the *even*-based approach may be reconciled with this set of empirical data. To achieve this, we propose (i) that EVEN be decomposed into the two focus parti-

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cles EVEN_{MIN} and EVEN_{MAX} (cf. Crnič, 2012; Lahiri, 2010), (ii) that *any* is only licensed by EVEN_{MIN}, (iii) that overt *even* is licensed by the combination of EVEN_{MIN} and EVEN_{MAX}, (iv) that, crucially, EVEN_{MAX} carries an additional presupposition of exclusivity, (v) that the difference in the universal quantifier's restrictor is derivable via local accommodation of EVEN_{MAX}'s aforementioned presupposition, and (vi) that the difference in question bias is the result of the same projected presupposition of exclusivity from EVEN_{MAX}.

(1) a. LF for *any*
$[\ \text{even}_{\text{MIN}}\ [_{\not\uparrow} \ldots [_{\uparrow} \ldots \text{one}_F \ldots]\,]\,]$
b. LF for *even ONE*
$[\ \text{even}_{\text{MIN}}\ [_{\not\uparrow} \ldots [\ \text{even}_{\text{MAX}}\ [_{\uparrow} \ldots \text{one}_F \ldots]\,]\,]\,]$

In §2 we go into how NPIs are traditionally viewed and how they are modelled under the *even*-based approach to NPIs (see §2.1). In §3 we go into how rhetorical questions can be derived (see §3.1), how polar questions are analysed according to Guerzoni and Sharvit's (2014) question model (see §3.2), and how these question models fail to handle the difference in question bias with a non-decomposed EVEN. In §4 we then decompose the NPI-licensing EVEN into the two focus sub-particles EVEN_{MIN} and EVEN_{MAX}. We then show in §4.2 how the difference in question bias is obtained with this decomposed model of weak EVEN.

2. NPI licensing

Accounting for NPIs is a complex issue in formal semantics. Any model that seeks to license them needs to have a unified analysis for a wide range of different licensing environments. See below for a (non-exhaustive) list of NPI-licensing and non-licensing constructions.

(2) a. #John read any book.
b. John didn't read any book.
c. Exactly two students read any book.
d. Every student who read any book passed the exam.
e. Did John read any of the relevant books?

NPIs are not licensed within simple affirmative declarative sentences. They are licensed under negation, within the restrictor of universal quantification, under *only*, within the antecedent of a conditional, within questions, and within the scope of some non-monotone quantifiers.

The first workable model that covered a wide range of the known empirical data was put forth by Fauconnier (1975) and Ladusaw (1979). Their model of licensing was based upon the monotonicity of the environment containing the NPI in question: According to their model, an NPI is licensed iff it occurs within a downward-monotone environment. Later on, their model was improved upon by von Fintel (1999, 2001), who extended their account to cover more empirical data, by lessening the restrictions to Strawson downward-monotone environments (environments that are shown to be downward-monotone given the right circumstances). Together, they form the traditional mainstream line of thought concerning how NPIs are licensed. We refer to their model, and other models like them, as the monotonicity-based approach to NPI licensing (or, alternatively, the Fauconnier-Ladusaw-Fintel approach).

Naturally, over the years, other models developed that diverged from these monotonicity-based models: Krifka (1995) and Chierchia (2013), to name two of the more substantive ones. However, recently one particular line of thought rose to greater prominence: the *even*-based approach to NPI licensing. Originally ruled out as a viable candidate by Heim (1984), the idea that NPIs are to be licensed by a (covert) EVEN at LF was nevertheless picked up by a number of authors over the years. Amongst them are Lee and Horn (1994), Lahiri (1998), and Crnič (2014a, b).

2.1. *Even*-based approach to NPI licensing

An alternative approach to NPI licensing is based upon the focus particle *even*. The essential idea behind this approach is that every NPI is covertly licensed by EVEN at LF. This notion was first considered by Heim (1984) as she noted the similarity in distribution between the expression *even ONE* and the NPI *any*. See below for the *even ONE* counterparts to (2).

(3) a. #John read even ONE book.
    b. John didn't read even ONE book.
    c. Exactly two students read even ONE book.
    d. Every student who read even ONE book passed the exam.
    e. Did John read even ONE book?

As we can see, there is an exact match between the felicity distribution of *even ONE* and the NPI *any* (at least for this limited range of data). However, this approach was initially ruled out by Heim (1984) herself, after she encountered some differences that are not easily accounted for: First, that the felicity of *even ONE* in (3d) is context-dependent, as can be seen below, whereas its NPI counterpart is felicitous, regardless from contextual influences.

(4) a. Every student who read any book wore blue jeans.
    b. #Every student who read even ONE book wore blue jeans.

Second, it was noted that questions containing the expression *even ONE* are negatively biased (i.e. the positive answer is strictly unexpected), whereas their NPI counterparts are not.

(5) a. Did John read any book?
        (i) Yes, he did.
        (ii) No, he didn't.
    b. Did John read even ONE book?
        (i) #Yes, he did.
        (ii) No, he didn't.

As mentioned before, the *even*-based approach was nevertheless picked up by a number of authors. Prominent examples would be Lee and Horn (1994), who first proposed that NPIs are always composed of a covert EVEN and an existential quantifier; Lahiri (1998), who has shown that this approach is a natural selection for Hindi (its NPIs are transparently consist of an *even*-like particle and existential quantification); and Crnič (2014a, b), who has shown that this approach is able to account for the distributional difference in (4) and the licensing of NPIs in non-monotone environments such as in (2c). The approach also accounts for the infelicity of NPIs in upward-monotone environments and the felicity in downward-monotone ones.

Now that we have an overview over the empirical data, the history of the *even*-based approach, and what the approach is currently able to account for, we must consider *how* it accounts for them. To do this, we first list a number of assumptions most adherents to this approach typically make: (i) EVEN may move freely at LF (Karttunen and Peters, 1979); (ii) focus generates a set of possible alternatives to the focused element (Rooth, 1992); (iii) EVEN has no assertive contribution, but presupposes that its prejacent proposition is the least likely member of its set of focus alternatives (Karttunen and Peters, 1979; Kay, 1990); (iv) NPIs are semantically equivalent to indefinites (Lee and Horn, 1994; Lahiri, 1998); (v) NPIs also induce alternatives that are utilized by some alternative-sensitive operators (Krifka, 1995; Chierchia, 2013); (vi) NPI-licensing EVEN only associates with weak predicates (therefore also referred to as weak EVEN) (Crnič, 2011a, 2014a, b); and (viii) predicates are considered weak, iff they are the most probable member of their focus set (Crnič, 2011a, 2014a, b). See below for the formal definition of weak EVEN, where $\lhd_c$ represents the function *less likely than*:

(6) $[\![\text{even}]\!](C)(p)(w) = p(w)$ is defined iff $\forall q \in C[p \neq q \rightarrow p \lhd_c q]$

Another important piece of formal machinery is Kolmogorov's (1933) third axiom of probability that says that any proposition ϕ that entails any proposition ψ is at most as likely ψ:

(7) *Kolmogorov's (1933) third axiom of probability*
If $\phi \Rightarrow \psi$, then $\phi \unlhd_c \psi$.

Equipped with these assumptions we may now review the current state of the literature on how the (in-)felicity of the different environments are derived. We review how the *even*-based approach handles upward-, downward-, and non-monotone environments. We furthermore review how the Crnič (2014a) accounts for the differences in the universal restrictor and how the difference in question bias can not be accounted for with the current model. We refer to the aforementioned literature on *even* and the *even*-based approach for details on those environments which we do not expand upon.

UPWARD-MONOTONE ENVIRONMENTS and their infelicity are easily accounted for under the *even*-based approach. For the sentence (8), we would derive the following presupposition:

(8) #John read any/even ONE book.
  a. even [John read one$_F$ book]
  b. For $n > 1$: $\exists_1 x[\text{BOOK}(x) \wedge \text{READ}(j,x)] \lhd_c \exists_n x[\text{BOOK}(x) \wedge \text{READ}(j,x)]$

In an upward-monotone environments, entailing relations are preserved. Ergo, the original prejacent entails all of its focus alternatives, as can be seen below.

(9) John read at least n books $\Rightarrow$ John read at least one book

Thereby, according to the axiom of probability in (7), it must be the most probable alternative. This is diametrically opposed to EVEN's felicity requirements, causing the sentence to crash.

DOWNWARD-MONOTONE ENVIRONMENTS, on the other hand, reverse entailing relations:

(10) John didn't read at least one book $\Rightarrow$ John didn't read at least n books

Therefore, the same principle of probability now enforces that *not at least one* is the least likely member of its focus set. Thus, there can never be a downward-monotone environment in which *even ONE* (and thereby NPIs) are infelicitous, explaining the NPIs perceived link to them.

(11) John didn't read any/even ONE book.
  a. even [not [John read one$_F$ book]]
  b. For all $n > 1$: $\neg\exists_1 x[\text{BOOK}(x) \wedge \text{READ}(j,x)] \lhd_c \neg\exists_n x[\text{BOOK}(x) \wedge \text{READ}(j,x)]$

NON-MONOTONE ENVIRONMENTS suspend all entailing relations. As such, Kolmogorov's (1933) third axiom of probability holds no influence over the felicity of such sentences. Therefore, it comes as no surprise that not all non-monotone environments license NPIs. Critically, Crnič (2011a, 2014b) noted that for sentences containing the expression *exactly n*, it appears that the varying number n is the most decisive factor for felicity. Consider this scenario:

(12) Context: There is a lecture with 500 enrolled students. The professor announced ten relevant books before the start of the semester. The first class is now over. The professor relates her experience to one of her colleagues.
  a. Exactly two students read any/even ONE book.
    (i) even [exactly two students read one$_F$ book]
    (ii) For all $n > 1$: $\exists!_2 x[\text{STUDENT}(x) \wedge \exists_1 y[\text{BOOK}(y) \wedge \text{READ}(x,y)]]$
    $\lhd_c \exists!_2 x[\text{STUDENT}(x) \wedge \exists_n y[\text{BOOK}(y) \wedge \text{READ}(x,y)]]$
  b. #Exactly 250 students read any/even ONE book.
    (i) even [exactly 250 students read one$_F$ book]
    (ii) For all $n > 1$: $\exists!_{250} x[\text{STUDENT}(x) \wedge \exists_1 y[\text{BOOK}(y) \wedge \text{READ}(x,y)]]$
    $\lhd_c \exists!_{250} x[\text{STUDENT}(x) \wedge \exists_n y[\text{BOOK}(y) \wedge \text{READ}(x,y)]]$

It appears that the sentence is only felicitous, if n refers to a contextually low quantity. Crnič (2014b) advocates that the fulfillment of the scalar presupposition is determined by our expectations and general world knowledge, as there are no axioms of probability to guide us. In our example, our general expectations would have been (i) that most students read at least one book, (ii) some students read more than one book, and (iii) that very few students read all ten books. The further the number of students having read n books deviates from these assumptions, the more unexpected the respective proposition becomes. See figure 1 for a graph that represents our general expectations for this scenario.

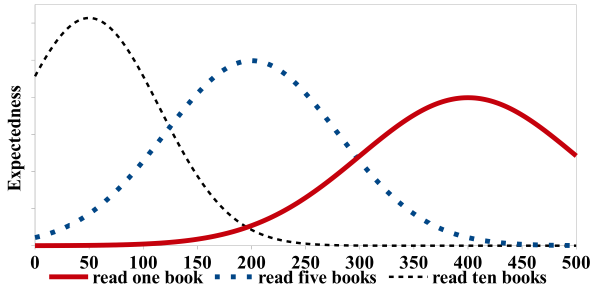

Figure 1: Expectedness graph of (12) and its alternatives. The x-axis represents the number of students having read n books. The y-axis to the expectedness of the assertion.

By converting our expectations of the world into probabilities, we can see that the original assertion of (12a) scores the lowest available probability for its value of n (fulfilling the scalar presupposition of EVEN). The infelicitous sentence in (12b), however, does not.

IN THE RESTRICTOR OF UNIVERSAL QUANTIFICATION, we have a seeming difference in distribution between weak *even* and NPIs. Whilst NPIs are universally felicitous, its counterpart *even ONE* is not. Below is the expected LF and presupposition for the NPI sentence:

(13) Every student who read any book passed the exam.
  a. [even [Every student who read one$_F$ book passed the exam]]
  b. For all $n > 1$: $\forall x[\text{STUDENT}(x) \wedge \exists_1 y[\text{BOOK}(y) \wedge \text{READ}(x,y)] \rightarrow \text{PASS}(x, \iota v[\text{EXAM}(v)])]$
  $\lhd_c \forall x[\text{STUDENT}(x) \wedge \exists_n y[\text{BOOK}(y) \wedge \text{READ}(x,y)] \rightarrow \text{PASS}(x, \iota v[\text{EXAM}(v)])]$

Being (Strawson) downward-monotone, one can easily see that this scalar presupposition is fulfilled, regardless of any correlation between the restrictor of the quantifier and its verb phrase. As such, the general felicity of NPIs in this environment is derived. But how do we account for the context-sensitivity of *even ONE*? According to Crnič (2014a), the focus particle in (16) violates Crnič's (2011b) principle of non-vacuity (see his paper for details on how):

(14) *Principle of Non-Vacuity*
"The meaning of a lexical item used in the discourse must affect the meaning of its host sentence (either its truth-conditions or its presuppositions)" (Crnič, 2011b) or its presence must be required on structural grounds (Crnič, 2014a: p. 133).

As a means to rescue the use of *even*, he proposes that there is a covert exhaustifying operator EXH that asserts that all alternatives that are not entailed by the original are false. This operator is obligatorily used to ensure that the contribution of EVEN is non-vacuous.

(15) $[\![\text{Exh}]\!] = \forall q \in C[p \not\Rightarrow q \rightarrow q(w) = 0]$

(16) Every student who read any book passed the exam.
  a. [even [Every student wh$_x$ [exh(C) x read one$_F$ book] passed the exam]]
  b. For all $n > 1$: $\forall x[\textsc{student}(x) \wedge \exists!_1 y[\textsc{book}(y) \wedge \textsc{read}(x,y)] \rightarrow \textsc{pass}(x, \iota v[\textsc{exam}(v)])]$
  $\lhd_c \forall x[\textsc{student}(x) \wedge \exists!_n y[\textsc{book}(y) \wedge \textsc{read}(x,y)] \rightarrow \textsc{pass}(x, \iota v[\textsc{exam}(v)])]$

It accomplishes this purpose by changing the weak existential existential *at least one* into *exactly one*, since all higher-numbered alternatives are negated. This suspends the entailing relations that enforce the felicity of *even*. Since the axiom of probability in (7) no longer affects our judgment, we have to rate the asserted proposition against its alternatives based upon our world knowledge and expectations. As there is a correlation between reading (relevant) books and passing the exam, we would expect that the more books you read, the more likely you are to pass it. As such, our presupposition would be fulfilled. If we exchange our VP with *wore blue jeans* (see (4)), however, our world-knowledge should dictate an expected correlation between wearing blue jeans and the number of books read.

3. The issue of questions

Before we go on to see how the *even*-based approach has problems with deriving the (non-)bias of questions, we first give a sketch on how bias/rhetoricity is derivable. This is followed by an overview of Guerzoni and Sharvit's (2014) question model and the problems contemporary question models have with a non-decomposed version of EVEN (with respect to the *even*-based approach to NPI licensing).

3.1. Rhetoricity

There are multiple theories concerning how rhetorical questions derive their rhetoricity. Not all of them are mutually exclusive. In this paper, we present two known ways to derive rhetoricity. The first was proposed by Guerzoni (2003), whereas the second theory was first proposed by van Rooy (2003) and Rohde (2006). Guerzoni (2003) proposes that a question must be considered rhetorical, if only one felicitous answer to the question is derived by the LF of the question form. The second approach is based upon the average informativity of the question (or rather, the lack thereof) and requires some general explanations.

The first approach to rhetoricity was designed by Guerzoni (2003), who focused entirely on the distribution of *even* in questions and how it can be used to derive its negative bias. In her semantics, there are two possible structures for questions containing a focus particle such as *even*. In either structure, however, the focus particle would scope above both answers to the polar question. The only possible difference is whether or not the particle scopes above or below the negation in the negative answer. For *even*, this would result in the following possible structures:

(17) Did John read even ONE book?
  a. $\{\#[\![\text{even}]\!](C)([\![\text{John read one}_F\text{ book}]\!]), \#[\![\text{not}]\!]([\![\text{even C [John read one}_F\text{ book]}]\!])\}$
  b. $\{\#[\![\text{even}]\!](C)([\![\text{John read one}_F\text{ book}]\!]), [\![\text{even}]\!](C)([\![\text{not [John read one}_F\text{ book]}]\!])\}$

In (17a), EVEN always associates with an upward-monotone environment. As such, as detailed in §2.1, both answers would be considered infelicitous, since the scalar presupposition is unfulfillable. In (17b) the affirmative answer is still infelicitous. However, the negative answer has EVEN associated with a downward-monotone environment, thereby fulfilling its scalar presupposition (as detailed before). Therefore, the only possible answer that fulfills the scalar presupposition would be the negative answer of the second LF. This renders the question itself rhetorical, as reasoned by Guerzoni (2003), since there is but one possible felicitous answer.

The second approach is based upon the informativity of a question and was mostly characterised by van Rooy (2003). The essential idea is, that you seek to gain the most information possible to the question you ask. Starting with very general questions, the more knowledge you already possess about the respective state of the world, the more specific your questions become. In his paper, he explains how we can derive the rhetoricity of minimizer questions:

(18) Did John (even) LIFT A FINGER to help?

The minimizer, which is licensed by EVEN, invokes a presuppositional scale of helpful contributions. It also presupposes that the value is known for all units of help except for two: one and zero. In essence, according to van Rooy (2003), the minimizer restricts the range of helpful contributions to the lowest part of the contextually relevant scale. The question whether he did the minimal amount of work or no work at all still remains uncertain. The rhetorical effect is then achieved, according to van Rooy (2003), as follows: Whilst either answer is equally probable, due to the fact that either answer reflects very negatively on John, the actual answer itself does not really matter. As such, the informativity of the question can be judged to be considerably lower than its minimizer-less alternative which does not restrict John's helpfulness to such a degree.

3.2. Environments in questions approach

The approach to polar questions by Guerzoni and Sharvit (2014) contrasts with traditional question models (cf. Karttunen, 1977) in that they encode all possible answers to the question within the syntax of the question's LF. They do this by arguing that polar questions are alternative yes-or-no questions containing an optionally silent *whether (or not)*. Instead of assuming that a question operator derives both answers from a single LF, they assume that both answers are present within the LF and linked via disjunction. One of them is pragmatically omitted, however, via ellipsis. They would argue that a question like *Did John kiss Mary(, or not)?* would have the following LF:

(19) [whether^L] [7 ? [[John kissed Mary] (or$_7$ [not) [~~John kissed Mary~~]]]]

Within this structure, one of the options is elided by pragmatical omission. This can only be done when both answers share an identical structure, which is a necessity of any polar question (under the assumption that negation scopes over a proposition and is not analysed *in situ*).

The definitions for the relevant lexical items, $[\![\text{whether}^L]\!]$, $[\![?]\!]$, and $[\![\text{or}_7]\!]$, are provided below. Note that the *or* has a co-indexation to the trace left by the movement of *whether*, deviating from its standard form insofar that it is considered to be a Heimian indefinite.[2] This assumption was adopted from Rooth and Partee (1982).

(20) a. $[\![\text{whether}^L]\!] = [\lambda Q_{\langle\langle s,t\rangle,\langle\langle s,t\rangle,t\rangle\rangle}.[\lambda q_{\langle s,t\rangle}.\exists! r_{\langle s,t\rangle}[Q(r)(q) = 1 \wedge q(w) = 1]]]$
b. $[\![\text{or}_7]\!] = [\lambda P_{\langle\sigma,t\rangle}.[\lambda Q_{\langle\sigma,t\rangle}.[\lambda z_\sigma.(g(7) = P \vee g(7) = Q) \wedge g(7)(z) = 1]]]$
c. $[\![?]\!] = [\lambda p_{\langle s,t\rangle}.[\lambda p_{\langle s,t\rangle}.p = q]]$

Using these definitions, the sentence structure in (19) derives the following Hamblin set in (21) as its meaning. Compare this meaning to the LF structure in (19).

(21) $[\![\text{Did John kiss Mary?}]\!] = \{[\![\text{John kissed Mary}]\!], [\![\text{not [John kissed Mary]}]\!]\}$

Notice the exact correspondence of the individual answers to how the LF was structured. One of the major reason's for Guerzoni and Sharvit (2014)'s approach's perceived elegance is this exact one-to-one correspondence. As such, we do not go into details concerning exactly how the final Hamblin set is derived. We refer to Guerzoni and Sharvit (2014: p. 212ff.) for details.

The major difference to Guerzoni (2003) in relation to NPIs also lies with the expanded alternative structure of polar questions: If the negative clause is directly represented at LF, then the EVEN need not be applied to both sides simultaneously (cf. Guerzoni, 2003). In Crnič (2014a, b)'s adaptation of Guerzoni and Sharvit (2014)'s question model, we assume that NPI-licensing EVEN is only generated in the downward-monotone environment underneath the negation. The EVEN is then raised above the negating element, leaving the substructures of the affirmative and negative answer identical:

(22) [whether^L] [7 ? [[~~John kissed one girl~~] (or$_7$ [even C [not) [John kissed one$_F$ girl]]]]]

Since the constituents are equal to one another, the elision of the affirmative answer is licensed as a pragmatic omission. As such, we arrive at the following generalized structure for sentences containing an NPI-licensing *even*:

(23) [whether^L] [7 ? [~~CP~~ (or$_7$ [even [not) CP]]]]

Which, in turn, derives the following Hamblin sets:

(24) a. $[\![\text{Did John kiss even one}_F \text{ girl?}]\!] = \{[\![\text{John kissed one girl}]\!],$
$[\![\text{even}]\!](C)(\neg[\![\text{John kissed one}_F \text{ girl}]\!])\}$
b. $[\![\text{Did even CP?}]\!] = \{[\![\text{CP}]\!], [\![\text{even}]\!](C)(\neg[\![\text{CP}]\!])\}$

Accordingly, under this question model, any questions containing an NPI-licensing EVEN are predicted not to exhibit any kind of bias, since either answer is considered to be felicitous.

[2] A Heimian indefinite is a restricted variable bound by another operator further up in the LF. See Heim (1982) for further details on this topic.

Under the assumption of the simple *even* hypothesis, this would correctly predict the non-bias of questions containing NPIs. Therein also lies the problem: Since we do not make a distinction between *even ONE* and *any*, questions containing an overt *even ONE* are incorrectly predicted to be unbiased. So far, two attempts have been made to rectify this erroneous prediction: The first correction was attempted by Guerzoni and Sharvit (2014: p. 216, footnote 18) themselves. They proposed the following LF to derive negative bias for such questions:

(25) [whether^{L}] [7 ? [~~[[*even C*] *CP*]~~ (or$_7$ [[even C] [not) CP]]]]

This structure would correctly assign an infelicitous reading to the affirmative question. However, Crnič (2014a) correctly pointed out that such structures violate the constraint on ellipsis:

(26) *Constraint on Ellipsis*
A constituent α may be elided if it is contained in a constituent β that contrasts with an antecedent constituent β' (where β contrasts with β' if and only if the meaning of β' is in the focus value of β).

The second attempt to correct the erroneous prediction was carried out by Crnič (2014b). He had drawn parallels to the conundrum he faced with Strawson downward-monotone environments and suggested that the use of covert exhaustification might improve matters. As such, he considered the following LF structure:

(27) [whether^{L}] [7 ? [John kissed one girl (or$_7$ [[even C] [not) Exh John kissed one$_F$ girl]]]]

Crnič (2014b: p. 206) reasons that the sentence's scalar presupposition entails that John is less likely to have kissed a high number of girls in contrast to having kissed fewer girls.

(28) $[\![\text{even}]\!](C)(\neg[\![\text{Exh C [John kissed one}_F\text{ girl]}]\!])$ is defined iff for all $n > 1$:
That *John did not kiss exactly one girl* $\lhd_c$ that *John did not kiss exactly n girls*.

Crnič (2014b) himself states that this presupposition is not an exact match to the negative bias observed. It might, however, be an additional presupposition that accompanies NPI questions anyway. But that is beside the point. So far, no solution has been found regarding the difference in bias between *even ONE* and unstressed NPI questions.

4. Decomposing weak *even*

This still leaves us, however, with the problem of how to derive the presuppositions that induce the questions' rhetoricity. Having exhausted all possible configurations with Guerzoni and Sharvit's (2014 question model, we need to innovate to find an LF that might derive the question's negative bias. In line with Lahiri (2010) and Crnič's (2012) analyses of weak scalar particles, we therefore propose that *even* is morphologically complex. That is to say, EVEN decomposes into two separate focus particles. In Crnič's (2012) analysis, he proposes that some scalar particles decompose into $[\![\text{even}]\!]$ and its antonym $[\![\neg\text{even}]\!]$.

(29) a. $[\![\text{even}]\!](C)(p)(w) = p(w)$ is defined iff $\forall q \in C[p \neq q \rightarrow p \lhd_c q]$
b. $[\![\neg\text{even}]\!](C)(p)(w) = p(w)$ is defined iff $\forall q \in C[p \neq q \rightarrow q \lhd_c p]$

We propose that EVEN decomposes into two similar focus particles: EVEN_{MIN} and EVEN_{MAX}. The former is identical to standard weak EVEN, whereas the latter has no at-issue contribution but two separate presuppositions: First, that its prejacent is the most probable alternative, and second, that all alternatives that are not entailed by its original prejacent are false. In essence, we adopt Crnič's (2012) model, with the exception of an added presupposition of exclusivity.[3]

(30) a. $[\![\text{even}_{\text{MIN}}]\!](C)(p)(w) = p(w)$ is defined iff $\forall q \in C[p \neq q \rightarrow p \lhd_c q]$
b. $[\![\text{even}_{\text{MAX}}]\!](C)(p)(w) = p(w)$ is defined iff $\forall q \in C[p \neq q \rightarrow q \lhd_c p]$, and $\forall q \in C[p \not\Rightarrow q \rightarrow q(w) = 0]$

We independently motivate this decomposition by two factors: (i) Some element is required to enforce weak EVEN's pairing with weak predicates, and (ii) to account for the presupposition of exclusivity exuded by sentences of the same type as below:

(31) a. John doesn't even know how to START a computer.
⇒ John doesn't know how to do any activity with a computer.[4]
b. Exactly two of her friends even know how to START a computer.
⇒ None of her friends know how to do anything else with a computer.

While the first sentence would be easily accounted for with an additive particle that might accompany EVEN, the latter would not be (Crnič, 2011a: p. 157). With our account, however, both of the above readings are derivable, as shown below.

(32) John doesn't even know how to START a computer.
a. [even_{MIN} [not [even_{MAX} [John knows how to start_F a computer]]]]
b. Presupposition of EVEN_{MIN}:
For all *R*: It is less likely that *John doesn't know how to start a computer* than *John doesn't know how to R a computer*.
c. Presupposition of EVEN_{MAX}:
For all $R \neq [\![\text{start}]\!]$: It is more likely that *John knows how to start a computer* than *John knows how to R a computer*, and John does not know how to *R* a computer.

The computation of the other sentence is less straightforward, as it contains an instance of presupposition projection. For the purposes of this paper, we assume that presuppositions under quantifiers project universally (cf. Heim, 1983).[5] Under this assumption, we derive the following presuppositions:

[3] It should be noted that adding a presupposition of exclusivity virtually renders EVEN_{MAX} identical to Guerzoni's (2003) $only_2$ in her analysis of German scalar particle *auch nur*.

[4] Note that we intentionally do not use a predicate that is entailed by all of its alternatives. If the alternatives were entailed, then the negation itself would already result in the correct reading. Theoretically, people exist who might not know how to start a computer, but are perfectly able to use it for specific tasks (e.g. writing).

[5] This assumption, however, is not crucial, and existential projection leads to a weaker, but also tenable claim.

(33) Exactly two of her friends even know how to START a computer.

a. [even_{MIN} [exactly two of her friends [1 [even_{MAX} [t_1 knows how to start_F a computer]]]]]

b. Presupposition of EVEN_{MIN}:
For all R: It is less likely that *Exactly two of her friends know how to start a computer* than *John doesn't even know how to R a computer*.

c. Presupposition of EVEN_{MAX}:
For all $R \neq [\![\text{start}]\!]$: It is more likely for all of her friends to know how to start a computer, rather than how to R a computer (individually, not collectively), and all of her friends do not know how to R a computer.

Now that we have sufficiently motivated our decision to decompose EVEN, we proceed to show how this analysis would fare with the different kinds of environments we find it in (cf. §2). Note that this analysis simply adds additional presuppositions upon the already existing analysis. As such, any LF that was already ruled out by our previous non-decomposed approach, will also be ruled out under this approach, as their presuppositions will still remain unfulfilled. We therefore refrain from showing the presuppositions of EVEN_{MAX} under upward monotone environments. Also note that we propose that only overt *even* requires to be licensed by EVEN_{MAX}. As such, the analysis for sentences containing an NPI remains the same and is not reiterated here.

DOWNWARD-MONOTONE ENVIRONMENTS remain as straight-forward as they used to be under the original *even*-based account. In downward-monotone environments, EVEN_{MAX} moves to take scope over the upward-monotone expression, beneath the downward-monotone operator. As such, if the predicate is weak, the presupposition is an automatic success due to Kolmogorov's third axiom of probability.

(34) John didn't read even ONE book.

a. [even_{MIN} [not [even_{MAX} [John read one_F book]]]]

b. Assertion:
$[\![(34)]\!] = \neg\exists_1 x[\text{BOOK}(x) \wedge \text{READ}(j,x)]$

c. Presupposition of EVEN_{MIN}:
For all $n > 1$: $\neg\exists_1 x[\text{BOOK}(x) \wedge \text{READ}(j,x)] \lhd_c \neg\exists_n x[\text{BOOK}(x) \wedge \text{READ}(j,x)]$

d. Presupposition of EVEN_{MAX}:
For all $n > 1$: $\exists_n x[\text{BOOK}(x) \wedge \text{READ}(j,x)] \lhd_c \exists_1 x[\text{BOOK}(x) \wedge \text{READ}(j,x)]$, and $\neg\exists_n x[\text{BOOK}(x) \wedge \text{READ}(j,x)]$

The presupposition of exclusivity is also successful and precludes the possibility of John having read more than one book, which is entirely compatible with the sentence's asserted content.

NON-MONOTONE ENVIRONMENTS remain as context-sensitive as they used to be. The presupposition of EVEN_{MIN} remains responsible for the context-sensitivity of the expression.

(35) Exactly three students read even ONE book.

a. [even_{MIN} [exactly three students [1 [even_{MAX} [t_1 read one_F book]]]]]

b. Assertion:
$[\![(35)]\!] = \exists!_3 x[\text{STUDENT}(x) \wedge \exists_1 y[\text{BOOK}(y) \wedge \text{READ}(x,y)]]$

c. Presupposition of EVEN_{MIN}:
For all $n > 1$: $\exists!_3 x[\text{STUDENT}(x) \wedge \exists_1 y[\text{BOOK}(y) \wedge \text{READ}(x,y)]]$
$\lhd_c \exists!_3 x[\text{STUDENT}(x) \wedge \exists_n y[\text{BOOK}(y) \wedge \text{READ}(x,y)]]$

d. $\forall$-projected presuppositions of EVEN_{MAX}:
For all $n > 1$: $\forall y[y \in \mathscr{P} \rightarrow \exists_n x[\text{BOOK}(x) \wedge \text{READ}(y,x)]$
$\lhd_c \exists_1 x[\text{BOOK}(x) \wedge \text{READ}(y,x)]]$, and
$\forall y[y \in \mathscr{P} \rightarrow \neg\exists_n x[\text{BOOK}(x) \wedge \text{READ}(y,x)]]$

The presuppositions of EVEN_{MAX}, on the other hand, are a tad more complicated as they must be projected. The scalar presupposition remains trivial, as it still associates with an upward-monotone environment. The presupposition of exclusivity, however, projects in such a way that for all members of $\mathscr{P}$ it is true that they did not read more than one book. The set $\mathscr{P}$ represents the domain of the projection, which corresponds to the entire set of students (not only those three that have been mentioned). Coupled with the asserted content this entails that amongst all students, only the three students in question have read anything at all.

Having shown that the standard non-problematic environments are also accounted for by our extension of the original account, things are now ready to get interesting. We now go into how our account handles those cases that were considered problematic by Heim (1984). As demonstrated in the next two subsections, our account is able to explain the unwanted differences in a straightforward fashion and requires no added assumptions or mechanisms.

4.1. Restrictor of universal quantification

In the restrictor of universal quantification, things turn more complicated and, by extension, more interesting. Let us review what the LF of a relevant NPI sentence looks like. Being downward-monotone, the felicity is fulfilled and not influenced by external factors.

(36) Every student who read any book passed the exam.

a. [even [Every student who read one_F book passed the exam]]

b. For all $n > 1$: $\forall x[\text{STUDENT}(x) \wedge \exists_1 y[\text{BOOK}(y) \wedge \text{READ}(x,y)] \rightarrow \text{PASS}(x, \iota v[\text{EXAM}(v)])]$
$\lhd_c \forall x[\text{STUDENT}(x) \wedge \exists_n y[\text{BOOK}(y) \wedge \text{READ}(x,y)] \rightarrow \text{PASS}(x, \iota v[\text{EXAM}(v)])]$

For the LF of the corresponding *even*-counterpart, we first need to decide what happens with the presupposition under quantification. Let us consider the following possible projections:

(37) Every student who read even ONE book passed the exam.

a. $[\text{even}_{\text{MIN}}[[\text{every}[\text{student that}[1[\text{even}_{\text{MAX}}[t_1 \text{ read one}_F \text{ book}]]]]]\ [\text{passed the exam}]]]$

b. Unprojected presuppositions of EVEN_{MAX}:
For all $n > 1$: $\exists_n x[\text{BOOK}(x) \wedge \text{READ}(g(1),x)] \lhd_c \exists_1 x[\text{BOOK}(x) \wedge \text{READ}(g(1),x)]$, and $\neg\exists_n x[\text{BOOK}(x) \wedge \text{READ}(g(1),x)]$

c. $\forall$-projected presuppositions of EVEN_{MAX}:
For all $n > 1$: $\forall y[y \in \mathscr{P} \rightarrow \exists_n x[\text{BOOK}(x) \wedge \text{READ}(y,x)] \lhd_c \exists_1 x[\text{BOOK}(x) \wedge \text{READ}(y,x)]]$, and $\forall y[y \in \mathscr{P} \rightarrow \neg\exists_n x[\text{BOOK}(x) \wedge \text{READ}(y,x)]]$

d. $\exists$-projected presuppositions of EVEN_{MAX}:
For all $n > 1$: $\exists y[y \in \mathscr{P} \wedge \exists_n x[\text{BOOK}(x) \wedge \text{READ}(y,x)] \lhd_c \exists_1 x[\text{BOOK}(x) \wedge \text{READ}(y,x)]]$, and $\exists y[y \in \mathscr{P} \wedge \neg\exists_n x[\text{BOOK}(x) \wedge \text{READ}(y,x)]]$

For the universally projected presupposition of exclusivity, the reading we get would be far too strong for our intuitions. The sentence (37) does not give rise to the intuition that no student at all read more than one book. The existentially projected presupposition, too, does not match the intuitions that arise from this sentence: In this case, the exclusivity presupposition would presuppose that there is some student who has not read more than one book. Since the sentence is perfectly fine in a scenario where all students have read all the required books and it is taken to be a general statement, this also excludes the existentially projected presupposition. This leaves us with a third option: Shifting the presupposed content to the assertive level via local accommodation. And indeed, under the assumption that the presuppositions of EVEN_{MAX} are locally accommodated in the restrictor of the universal quantifier, we would derive the following assertion and presuppositions:[6]

(38) Every student who read even ONE book passed the exam.

a. $[\text{even}_{\text{MIN}}[[\text{every}[\text{student that}[1[\text{even}_{\text{MAX}}[t_1 \text{ read one}_F \text{ book}]]]]]\ [\text{passed the exam}]]]$

b. Assertion with local accommodation of EVEN_{MAX}:
$[\![(37)]\!] = \forall x[\text{STUDENT}(x) \wedge \exists!_1 y[\text{BOOK}(y) \wedge \text{READ}(x,y)] \rightarrow \text{PASS}(x, \iota v[\text{EXAM}(v)])]$

c. Presupposition of EVEN_{MIN} with local accommodation of EVEN_{MAX}:
For all $n > 1$: $\forall x[\text{STUDENT}(x) \wedge \exists!_1 y[\text{BOOK}(y) \wedge \text{READ}(x,y)] \rightarrow \text{PASS}(x, \iota v[\text{EXAM}(v)])] \lhd_c \forall x[\text{STUDENT}(x) \wedge \exists!_n y[\text{BOOK}(y) \wedge \text{READ}(x,y)] \rightarrow \text{PASS}(x, \iota v[\text{EXAM}(v)])]$

These assertive and presuppositional levels are nigh-equivalent to the ones derived by Crnič (2014a) in (16). As such, under the assumption of local accommodation, we derive the required context-sensitivity of *even* without resorting to the introduction of additional rescue operators (i.e. *Exh*). Under the assumption that NPIs were licensed by weak EVEN (i.e. by both of its sub-particles), we would also introduce context-sensitivity to (37)'s NPI counterpart. This is undesirable. To circumvent this problem, we proposed the following alteration to the original

[6]Note that we make no assertion on what happens to the scalarity presupposition of EVEN_{MAX}. There are two possible options. (i) The presupposition projects as usually, or (ii) the presupposition is also locally accommodated. However, this would lead to infelicitous propositions, and, as such, should be avoided as an option. Further research is required for how a presupposition trigger with multiple presuppositions projects with regard to its individual presuppositions.

even-based approach: Weak NPIs are licensed by covert EVEN$_{MIN}$ at LF. Overt instances of weak *even* and strong NPIs (e.g. minimizers), on the other hand, are licensed by the combination of EVEN$_{MIN}$ and EVEN$_{MAX}$. This means that we leave the existing analysis of weak NPIs under this approach entirely untouched: We only change the semantics of overt *even* and strong NPIs.

(39) *Summary of our proposal so far*
  a. Weak NPIs are licensed by EVEN$_{MIN}$
  b. Strong NPIs and overt weak *even* are licensed by EVEN$_{MIN}$ and EVEN$_{MAX}$
  c. EVEN$_{MAX}$ is locally accommodated in the restrictor of universal quantification, and thereby introduces the required context-sensitivity of weak *even*

Now that we have covered the environments that the *even*-based approach already accounted for, let us turn our eye to how questions are affected by our proposal.

4.2. Decomposed *even* and English polar questions

Given that we now assume that NPIs are licensed only by EVEN$_{MIN}$, the analysis for NPI questions remains the same as presented in §3.2. That is, they do not derive any kind of question bias or feeling of rhetoricity. Concerning the LF of *even*-questions, on the other hand, we would derive the following structure and Hamblin set:

(40) Did John read even ONE book?
  a. [whether^L] [7 ? [[~~John read one$_F$ book~~] (or$_7$ [even$_{MIN}$ [not) even$_{MAX}$ [John read one$_F$ book]]]]]
  b. ⟦Did John read any book?⟧ = {⟦John read one$_F$ book⟧, ⟦even$_{MIN}$⟧(C')(⟦not [even$_{MAX}$ C [John read focus$_F$ book]]⟧)}

The negative answer would have the following presuppositions:

(41) John didn't read even ONE book.
  a. [even$_{MIN}$ [not [even$_{MAX}$ [John read one$_F$ book]]]]
  b. Presupposition of EVEN$_{MIN}$:
  For all $n > 1$: $\neg\exists_1 x[\text{BOOK}(x) \wedge \text{READ}(j,x)] \lhd_c \neg\exists_n x[\text{BOOK}(x) \wedge \text{READ}(j,x)]$
  c. Presupposition of EVEN$_{MAX}$:
  For all $n > 1$: $\exists_n x[\text{BOOK}(x) \wedge \text{READ}(j,x)] \lhd_c \exists_1 x[\text{BOOK}(x) \wedge \text{READ}(j,x)]$, and $\neg\exists_n x[\text{BOOK}(x) \wedge \text{READ}(j,x)]$

Under the assumption that questions inherit the presuppositions of all of their possible answers (cf. Abrusán, 2014: p. 40, amongst others), this would entail that the question itself is only defined if we already preclude the possibility that John has read more than one book.[7] This

[7]Note that we can arrive at the same requirements, even if we do not assume that questions inherit all of their answer's presupposition. Under the assumption that questions only inherit presuppositions shared by all of their answers, we can simply maximize the ellipsis to ensure that EVEN$_{MAX}$ is also contained by the affirmative answer:

would mean that the speaker has already settled for herself that John will not have read any great amount of books. In fact, she assumes that he could have read at most one book, if any, which she also communicates to the addressee via the question form itself. This situation is identical to van Rooy's (2003) analysis of minimizer questions. We simply derive the necessary conditions for his derivation of rhetoricity in a different fashion. In fact, under our assumptions, minimizer-questions would derive their rhetoricity through the very same process as above, since we assume that strong NPIs are also licensed by the combination of both types of EVEN.[8] One caveat, however: Since overt *even* does not always associate with ludicrously minimal amounts (in comparison to lifting a finger), the derivation of rhetoricity is dependent upon the judgment of the speaker/addressee. Is the difference between nothing and one relevant to the situation? If so, the question would still be information-seeking. If not, the question would be considered rhetorical. As such, our proposal makes the following prediction: Not all instances of *even*-questions are rhetorical in nature. This difference would be determined by context.

5. Conclusion

The aim of this paper was to consider how the *even*-based approach NPI licensing can be reconciled with the differences in distribution between NPIs and the expression *even ONE* with the general assumption that NPIs are also licensed by EVEN. We have achieved this in §4, §4.1 and §4.2, where we have altered the semantics of overt *even*, whilst we left the analysis of NPIs untouched. Under our account, the impression that *even ONE* and *any* are licensed by the same factors was fabricated due to the fact that they share one important licensing factor: EVEN_{MIN}. In our account, however, overt *even* requires a second licensing EVEN_{MAX} that is solely responsible for all of the distributional differences pointed out by Heim (1984).

We are aware that our approach may have problems with accounting for the correct reading of some sentences such as the ones below.

(42) a. John regrets opening even ONE book.
b. John knows that asking out even ONE girl is a difficult task.
c. If John opens even ONE book, he will learn something new.

More precisely, our account is likely to make some predictions of exclusivity that are too strong to match our general intuitions for such sentences. A point for future research would be to examine how our account interacts with these environments and whether the presupposition of exclusivity might be dealt with in a similar fashion to the solution we provided for the universal quantifier's restrictor (or an entirely different approach for that matter). Another potential point for future research would be the empirical examination of our prediction concerning the

(i) Did John read even ONE book?
a. [whether^L] [7 ? [[~~even$_{\text{MAX}}$ John read one$_F$ book~~] (or$_7$ [even$_{\text{MIN}}$ [not) even$_{\text{MAX}}$ [John read one$_F$ book]]]]]

[8] It is interesting to note that minimizers and other strong NPIs are often considered to bear obligatory stress. The indefinite in *even ONE* also bears stress. A possibility for future research might be, whether an interaction with the stress itself somehow derives EVEN_{MAX}, possibly explaining why *any* turns into a strong NPI once stressed.

contextually-determined rhetoricity of *even*-questions. Another important point for future research is to analyse the projection of multiple presuppositions triggered by the same focus particle and empirically test whether all of them obligatorily project in the same manner.

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Polarity reversals under sluicing[1]

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Abstract. This paper presents novel English sluicing data that challenge even the most successful existing theories of the relationship between antecedent and elided content in sluicing constructions. The data supply robust evidence for a previously unobserved phenomenon in which the elided content and the antecedent content in a sluiced construction contain opposite polarity. The phenomenon challenges current accounts of identity conditions on ellipsis by demonstrating that a greater mismatch between antecedent and elided content is possible than previously thought; specifically, the paper shows that the identity condition for sluicing must be sensitive to pragmatic as well as to semantic content. This observation motivates a proposal in which sluicing is treated as a pragmatics-sensitive phenomenon licensed by local contextual entailment.

Keywords: ellipsis, sluicing, dynamic semantics, formal pragmatics, polarity

1. Introduction

Sluicing, first noted by Ross (1969), is an ellipsis phenomenon in which the TP of an interrogative is elided under some identity condition, stranding an overt wh-phrase in the CP domain. An example is given in (1) below.

(1) Bernie knows that someone in Iowa voted for Trump, but he doesn't know who$_i$ [$_{TP}$ ~~t_i in Iowa voted for Trump~~].

This paper discusses the previously unobserved phenomenon of polarity reversals[2] under sluicing. The phenomenon I am calling *polarity reversal* is that in which the antecedent and elided material in a sluicing construction contain opposite polarity. For example, the antecedent content (A) in (2), *Trump will comply*, has positive polarity while the elided content (E), *Trump won't comply*, has negative polarity.

(2) I don't think that [Trump$_i$ will comply]$_A$, but I don't know why [$_{TP}$ ~~he$_i$ won't comply~~]$_E$.[3]

[1]Thank you to Pranav Anand, Rachelle Boyson, and Jim McCloskey for bringing this phenomenon to my attention and for inspiring/providing much of the project's data. Thank you to Pranav Anand, Sandy Chung, Dan Hardt, Bill Ladusaw, Jim McCloskey, and Deniz Rudin for invaluable discussion of the ideas presented here, as well as audiences at UCSC, UC Berkeley, and SuB21. Finally, thank you to the undergraduate annotators of the Santa Cruz Ellipsis Project for their work in classifying the original corpus data. This project has in part been supported by a UC Santa Cruz Institute of Humanities Research cluster grant to the Santa Cruz Ellipsis Consortium, and by the National Science Foundation Grant No. 1451819: *The Implicit Content of Sluicing*.

[2]I use this label pre-theoretically and for convenience. As we will see, no actual "reversal" of polarity takes place between an antecedent and elision site.

[3]Note that there is a reading in which the antecedent includes the matrix clause, but this reading is pragmatically odd.

I show that data like (2) require a shift in current beliefs about the identity conditions that license sluicing constructions. I propose a theory of sluicing that builds on the advances made in previous accounts while allowing for greater mismatches between antecedent and elided content in order to accommodate the newly observed data.[4]

The paper proceeds as follows. Section 2 provides an overview of Merchant's (2001) theory of e-GIVENness and demonstrates that it fails to predict the polarity reversal data. Section 3 proposes an alternative theory and steps through its predictions for three polarity reversal examples. Section 4 addresses the concern of overgeneration that arises for pragmatic accounts of sluicing, and Section 5 concludes.

2. e-GIVENness

Numerous theories of sluicing have been proposed since the original syntactic isomorphy approach given in Ross (1969). The dominant semantics-based account of sluicing is Merchant's (2001) theory of e-GIVENness, which imposes a bidirectional semantic entailment identity condition on ellipsis. More recent theories have constrained the e-GIVENness account in various ways (Merchant 2005; Chung 2006, 2013; Barker 2013; AnderBois 2014). As these accounts are designed to be *more* restrictive than Merchant's original account, the objection outlined here that e-GIVENness undergenerates the polarity reversal data applies equally to these theories.[5]

2.1. Bidirectional semantic entailment

Merchant (2001) proposes that sluicing constructions are formed via wh-movement of a remnant constituent and subsequent deletion at PF of the remaining TP. e-GIVENness is a modification of Schwarzschild's (1999) GIVENness, which itself is a theory of focus and deaccenting. Schwarzschild proposes, drawing upon Rooth's (1985, 1992) theory of focus, that an expression can be deaccented if it is GIVEN, where GIVENness is defined as follows:

> <u>*Formal GIVENness Condition*</u>:
> An utterance B counts as GIVEN iff it has an antecedent A and:
> $\forall \langle w,g \rangle \in c\ \exists h\ [\text{ExClo}([\![A]\!]^{g})(w) \rightarrow \text{ExClo}([\![B]\!]^{g,h})(w)]$

Informally, GIVENness says that an expression can be deaccented if the existential focus closure of the expression is contextually entailed by the existential closure of an antecedent.[6]

[4]A methodological aside on the data used throughout: The corpus examples given here were identified by undergraduate annotators trained on the Santa Cruz Ellipsis Consortium. The properties of the sluices, including the provided pre-sluices, are those given by (at least) two independent annotators. After the annotation process, the judgments were verified by (an average of) ten trained linguists, including faculty and graduate students, in consultation with naïve speakers. Many of the examples presented here have more than one possible interpretation for the pre-sluice. The claim here is not that the pre-sluices provided for these examples are the *only* interpretation available for these examples, but merely that they are a felicitous, freely available interpretation in the context in which the sluice was found or constructed.

[5]Barros (2014) and Ginzburg and Sag (2001) take a different approach, combining syntactic and pragmatic constraints. See Kroll (in prep) for a discussion of these theories.

[6]Existential closure is a type-shifting operation that raises expressions to type ‹t› by existentially binding unfilled arguments.

Because Schwarzschild was concerned with deaccenting, his theory does not discuss ellipsis. However, Merchant draws upon the idea from Rooth (1992) and Romero (1997) that the licensing conditions for deaccenting and ellipsis are related, the strong version of which is to say that ellipsis is just an extreme version of deaccenting. Merchant notes, though, that the theory of GIVENness runs into a problem if applied faithfully to cases of ellipsis. Specifically, it fails to rule out impossible sluices such as (3), in which the elided content is entailed by the labelled antecedent (assuming *calling x an idiot → insulting x*), but is not judged to be a possible interpretation of the sluiced sentence.

(3) [Abby called someone an idiot]$_A$, but I don't know who [~~Abby insulted *t*~~]$_E$.

Based on such examples, Merchant proposes that GIVENness alone is not strong enough to act as a licensing condition for ellipsis. Merchant therefore strengthens GIVENness by requiring that the entailment relationship between the antecedent and elided expression be bidirectional instead of unidirectional. The account is given as follows:

Focus condition on TP-ellipsis: A TP α can be deleted only if α is e-GIVEN.

e-GIVENness: An expression E counts as e-GIVEN iff E has a salient antecedent A and, modulo ∃ type-shifting, i) A entails F-clo(E), and **ii) E entails F-clo(A).**

Note that condition (ii) is the novel aspect of the theory. Note also that the entailment requirement here is that of semantic entailment and, unlike GIVENness, does not leave room for contextual entailment.

The bidirectional entailment requirement of e-GIVENness will correctly rule out the problematic example given in (3), repeated below, as the elided expression does not entail the F-closure of the antecedent expression.

(3) [Abby called someone an idiot]$_A$, but I don't know who [~~Abby insulted *t*~~]$_E$.

<u>A entails F-clo(E)</u>: Yes.	<u>E entails F-clo(A)</u>: No.
A = ∃x.Abby called x an idiot	E = ∃x.Abby insulted x
F-Clo(E) = ∃x.Abby insulted x	F-Clo(A) = ∃x.Abby called x an idiot

2.2. e-GIVENness predictions

The semantic identity condition of e-GIVENness is permissive enough to allow for certain observed syntactic mismatches between sluiced clauses and their antecedents, such as tense (Merchant 2001); however, the bidirectional entailment requirement is too restrictive to allow for polarity mismatches. Let's look again at (2), repeated below as (4).

(4) I don't think that [$_{TP}$ Trump$_i$ will comply]$_A$, but I don't know why [$_{TP}$ ~~he$_i$ won't comply~~]$_E$.

Applying e-GIVENness to A and E yields the following:

A entails F-clo(E): No.
$A = \textbf{comply}(t)$
$\text{F-Clo}(E) = \neg\textbf{comply}(t)$

E entails F-clo(A): No.
$E = \neg\textbf{comply}(t)$
$\text{F-Clo}(A) = \textbf{comply}(t)$

Neither the antecedent expression nor the elided expression in (4) entails the other. An alternate possibility is to include the matrix clause in the antecedent, thereby capturing its negation in the antecedent expression. This is given in (5).

(5) [$_{TP}$ I don't think that Trump$_i$ will comply]$_A$, but I don't know why [$_{TP}$ ~~he$_i$ won't comply~~]$_E$.

A entails F-clo(E): No.
$A = \neg\forall w[w \in W_{dox,\, s} \rightarrow \textbf{comply}(t)(w)]$
$\text{F-Clo}(E) = \{w{:}\ \neg\ \textbf{comply}(t)(w)\}$

E entails F-clo(A): No.
$E = \{w{:}\ \neg\ \textbf{comply}(t)(w)\}$
$\text{F-Clo}(A) = \neg\forall w[w \in W_{dox,\, s} \rightarrow \textbf{comply}(t)(w)]$

As (5) shows, expanding the antecedent to include the matrix negation does not yield entailment in either direction. Indeed, my lacking a belief that Trump will comply does not semantically entail that Trump will not comply, as my lack of beliefs about an event does not entail any truth about the event itself. Notice that even if one argues that the stronger neg-raised interpretation of the antecedent, e.g. along the lines of Gajewski (2007) (see §3.1), counts as semantic content, we still do not have mutual entailment, as my thinking that Trump will not comply does not entail that he won't, as I can have false beliefs. Similarly, it will not work to take the matrix as antecedent, and the complement of *but* as the potential elided phrase,[7] as my thinking that Trump will not comply does not semantically entail my not knowing why he won't, as I may indeed know the reason he won't. I leave it to the reader to confirm the formal predictions here.

In summary, bidirectional semantic entailment accounts such as e-GIVENness are too restrictive and fail to predict the existence of polarity reversal data. The next section proposes an alternative account that builds off the insights of both GIVENness and e-GIVENness.

3. A modified account

This section presents a theory of sluicing that abandons semantic identity in favor of pragmatics-based entailment. The spirit of the proposal is indebted to those accounts already discussed and to the contextual entailment allowance that was included, though not given an exposition, in Schwarzschild's GIVENness. Informally, I propose that the TP of an interrogative can be elided if and only if the proposition expressed by the TP, modulo existential closure, is entailed by the context in which the proposition would be uttered. Formally, Local Givenness is expressed as follows:

[7] If one wanted to argue that, similar to focus licensing (Rooth 1985, 1992), one can have a larger expression license the deletion of a smaller contained expression.

Local Givenness (Preliminary): A TP α can be deleted iff *ExClo*($[\![\alpha]\!]^g$) expresses a proposition *p* such that $c_L \subseteq p$.

The relevant notion of context we are concerned with is the local context, c_L, in which *p* is expressed. The local context of a proposition *p* is more constrained and therefore not necessarily identical to the global context of the discourse in which *p* is uttered. For Stalnaker, the context set is updated as propositions are entered into the discourse and accepted by speakers as true for the purposes of the discourse (2002). However, propositions can be entered into local contexts without being entered into the context set, i.e. without being accepted as true of the actual world by the speakers of the discourse. Note that this means that, throughout a discourse, c_L is not a continually narrowing set of worlds. Instead, c_L is the set of worlds compatible with the presuppositions of the local proposition. While the account presented here is compatible with a range of dynamic theories, I assume the following basic formal reasoning (Kadmon 2001 and citations within):

Context update:

a. If c_L entails the presuppositions of *p*, then $c_L + p = \{c_L \cap p\}$

b. If c_L does not entail the presuppositions of *p*, then either:

i. undefined, or

ii. the presuppositions of *p* are accommodated, $c_L + p = \{(c_L \cap ps(p)) \cap p\}$

The following sections apply Local Givenness to three categories of polarity reversal sluices.[8]

3.1. Neg-raising polarity reversals

One class of polarity reversal sluices contains neg-raising verbs. For example, (2) is repeated below as (6):

(6) [I don't think that Trump$_i$ will comply]$_A$, but I don't know why [$_{TP}$ ~~he$_i$ won't comply~~]$_E$.

That neg-raising is the relevant property in (6) can be seen by swapping the neg-raising verb *think* with the non-neg raising verb *hope*, as in (7a). Example (7a) cannot receive the polarity reversal interpretation; the only available interpretation is that in which the matrix clause acts as antecedent, given in (7b).

(7) a. Mary doesn't hope that Trump$_i$ will comply, and she can't explain why [# ~~he$_i$ won't comply~~].

b. Mary doesn't hope that Trump will comply, but she can't explain why [she$_i$ ~~doesn't hope that Trump will comply~~].

Neg-raising verbs are clause-embedding verbs that when negated allow a reading in which matrix negation takes scope in an embedded clause. As it is arguably the dominant approach

[8] See Kroll (in prep) for derivations of polarity reversal examples containing *until*, *doubt*, and *say*.

in the literature, I use here the account of neg-raising given in Gajewski (2007).[9] Gajewski's account draws importantly on an idea from Bartsch (1973) that the inference from the literal interpretation of a neg-raising sentence like (6_A), where negation takes matrix scope, to the neg-raised interpretation, where negation takes embedded scope, is a pragmatic inference. Specifically, Bartsch argues that neg-raising verbs license an excluded middle presupposition as a pragmatic inference. For a sentence like (6_A) that contains the neg-raising verb *think*, the presupposition is that the subject either believes that the proposition expressed by the complement of the verb is true, or believes that it is false. The assertion of (6_A) combined with this presupposition then pragmatically entails that the speaker in (6) has a belief that Trump will not comply. The pragmatic nature of the reasoning involved explains how negation comes to be interpreted low and also explains why the neg-raised reading is cancellable in context. The criticism leveled against Bartsch's original account is that no principled reason is given for why some verbs are neg-raising verbs and others are not (Horn 1978). For example, no explanation is given for why the verb *think* can neg-raise while the epistemically stronger verb *know* cannot, or why neg-raising verbs are idiosyncratically distributed across different languages.

Gajewski proposes to alleviate this objection by categorizing the excluded middle presupposition of neg-raising verbs as a soft-trigger presupposition in the sense of Abusch (2005). Abusch's soft-trigger presuppositions are presuppositions that are easily cancellable in context and as such are distinct from hard-trigger presuppositions, which are not. Soft-trigger presuppositions are carried by predicates that invoke lexically-stipulated alternatives as a matter of convention. The invocation of these alternatives triggers a pragmatic presupposition that one of the alternatives is true. In the case of neg-raising verbs, the alternatives invoked are the literal interpretation of the sentence and the neg-raised interpretation of the sentence.

To summarize this discussion, Gajewski proposes to treat neg-raising predicates as soft triggers that invoke a pragmatic excluded-middle presupposition. This captures the behavior described in Bartsch's account while providing a more principled explanation for why some verbs allow neg-raising and others do not.

With this theoretical background in place we can now return to example (6). I have proposed that the assertion of (6_A) combined with the excluded-middle presupposition invoked by the verb *think* entails that the speaker in (6) has the belief that Trump will not comply. Formally, this is expressed as follows:

(6) [I don't think that Trump_i will comply]$_A$, but I don't know why [~~he_i won't comply~~]$_E$.

(6') $[\![\text{I don't think that Trump will comply}]\!]_A^{w,g} = \neg\forall w[w \in W_{dox,\,s} \rightarrow \mathbf{comply}(t)(w)]$

Via the excluded middle presupposition conventionally associated with the verb *think*, A presupposes the following:

Excluded Middle Presupposition of (6_A):
$[\forall w[w \in W_{dox,\,s} \rightarrow \mathbf{comply}(t)(w)] \vee \forall w\,[w \in W_{dox,\,s} \rightarrow \neg\,\mathbf{comply}(t)(w)]]$

[9] I ask my syntactically-inclined readers to please preview §3.2 to assuage objections to this choice.

The denotation of *think* assumed here can therefore be given as follows:

$$[\![\text{think}]\!]^{w,g} = \lambda p.\lambda x{:}[\forall w[w \in W_{\text{dox, x}} \rightarrow p(w)] \vee \forall w\,[w \in W_{\text{dox, x}} \rightarrow \neg\, p(w)]].$$
$$[\forall w[w \in W_{\text{dox, x}} \rightarrow p(w)]]$$

Because A expresses that the first disjunct of the excluded middle presupposition is false, the presupposition of A and the assertion of A together entail the second disjunct of the presupposition. This entailment produces the stronger reading that the speaker uttering (6) has a belief that Trump will not comply.

Local Givenness requires that the proposition elided in (6)—Trump will not comply—is entailed in its local context; however, as discussed, the strengthened neg-raising reading in (6)—that the speaker believes that Trump will not comply—does not semantically entail the elided proposition, as the speaker can have false beliefs. I argue here that the speaker's assertion of her belief of *p* can, in context and under certain conditions, be taken to assert *p* itself. This move relies on the proposal that, while doxastics such as *think* primarily report on the private mental state of an individual and therefore do not directly reference the common ground (or context), *think p* can be used in conversation to pragmatically assert *p*, as proposed in Anand and Hacquard (2014, 84).

The following steps apply Local Givenness to (6).

i. Starting Context:
   $c = W$

ii. (6_A) asserts that it is not true that the speaker believes that Trump will comply.

   Semantic Denotation of (A):
   $[\![\text{A}]\!]^{w,g} = \neg\forall w[w \in W_{\text{dox, s}} \rightarrow \textbf{comply}(\text{t})(w)]$

iii. The pragmatic excluded middle presupposition of (6_A)—conventionally associated with the verb *think*—requires that the speaker either believes that Trump will comply or believes that Trump will not comply.

   Excluded Middle Presupposition of (A):
   $[\forall w[w \in W_{\text{dox, s}} \rightarrow \textbf{comply}(\text{t})(w)] \vee \forall w\,[w \in W_{\text{dox, s}} \rightarrow \neg\,\textbf{comply}(\text{t})(w)]]$

iv. Steps (ii) + (iii) derive the strengthened neg-raised interpretation: Because (ii) asserts that it is not true that the speaker believes that Trump will comply, it follows from (iii) that the speaker believes that Trump will not comply. The utterance of (6_A) thus asserts the strengthened meaning given below.

   Strengthened Neg-Raised Interpretation of (A):
   $\forall w[w \in W_{\text{dox, s}} \rightarrow \neg\textbf{comply}(\text{t})(w)]$

v. The assertion in step (iv) creates a local context c_L in which the worlds under consideration are only those compatible with the speaker's doxastic state, namely those worlds in which Trump does not comply.

c_L for E: $W \cap \{w: w \in W_{\text{dox, s}}\} = \{w: \neg \textbf{comply}(t)(w)\} = c_{\text{LE}}$

vi. <u>Semantic Denotation of (E)</u>:
$\{w: \neg\ \textbf{comply}(t)(w)\}$

vii. The local context includes only those worlds in which Trump will not comply, which entails the elided proposition that Trump will not comply (in fact there is mutual entailment between the world sets).

<u>Local Givenness</u>:
$c_{\text{LE}} \subseteq ExClo([\![\text{E}]\!])^{w,g} = \{w: \neg \textbf{comply}(t)(w)\} \subseteq \{w: \neg \textbf{comply}(t)(w)\}$

The entailment satisfies the Local Givenness requirement that the elided proposition be entailed by its local context, and we predict felicitous elision of the proposition expressed by (6_{E}).

3.2. Polarity reversals over *remember*

The reader may, at this point, raise an objection that the previous example wrongly dismissed the possibility of a syntactic account of neg-raising as an explanation for the inference from $\neg\varphi p \rightarrow \neg p$. Indeed, the classic analysis of neg-raising—originally advanced by, among others, Fillmore (1963) and Ross (1973) and revived recently by Collins and Postal (2014)—argues for a syntactic explanation. However, I show in this section that an appeal to a syntactic account of neg-raising will not save a semantic entailment account of sluicing. Instead, the inference $\neg\varphi p \rightarrow \neg p$ must, at least in some cases, be purely pragmatic in nature.

Example (8) is a corpus polarity reversal sluice containing *remember*.

(8) [corpus example 91594, Santa Cruz Ellipsis Project]
Context: [O]n the day the Japanese invaded Pearl Harbor, Hummel was rounded up and locked in an internment camp along with about 2,000 other foreigners… So he and a British friend engineered an escape with the help of Nationalist guerrillas concealed nearby. He crawled over barbed-wire and walked most of the night and the next day. He was 20 and had no military training. But he was handed a small Belgian pistol, and he had little choice but to stay and help, harassing Japanese patrols by night and trying to defend a small patch of land against a communist takeover.

Sluice: "I don't know why [~~I wasn't scared~~], but I really can not remember being scared," [Hummel] said. "It all seemed like great fun."

Example (8) is illustrative in that it appears to behave like the neg-raising examples; specifically, $\neg$*remember p* is interpreted in context as entailing $\neg p$. However, *remember* is not classified as a neg-raising verb in the literature and, indeed, the inference is more contextually dependent than that carried by neg-raising verbs. For example, A's utterance in (9) is perfectly acceptable, while A's utterance in (10) is grammatical but a bit unwieldy.

(9) I don't remember being scared, but apparently I was!

(10) ? I don't think that John went to the party last night, but that's because I don't know anything about his whereabouts last night.

Karttunen (1971) classifies *remember* as an *implicative* verb. As such, *remember* has the following properties when taking an infinitival complement: *remember p* → *p*, ¬*remember p* → ¬*p*. For example, in (11) below there is a strong intuition that the assertion of the sentence commits the speaker to believing that she did not shut the door.

(11) I didn't remember to shut the door.

Higginbotham (2003) proposes that *remember* (along with *imagine*) in its usage with a gerund complement carries an obligatory *de se* reading when the embedded subject is PRO. For example, while (12) has both a possible *de re* and a possible *de se* reading, (13) carries only the *de se* reading, under which John remembers he himself going to the movies.

(12) John remembered his going to the movies.

(13) John remembered going to the movies. [Higginbotham 7&10]

Based on these discussions, I propose that the licensing of the inference ¬*remember p* → ¬*p* in (8) is licensed by two defeasible contextual assumptions. The first assumption is that the speaker has a memory about the particular event represented by *p*.[10] I argue that this assumption is stronger in cases in which the subject of *remember* is remembering their own experience of the particular event, as in Higginbotham's *de se* examples. The second assumption is based on the idea that insofar as our memory of eventualities track with our beliefs about those eventualities, a speaker's memory represents the speaker's beliefs about the way the actual world was in the past. An assertion of memory can therefore in context be taken as doxastic evidence for or against a description of a particular eventuality and license inferences from memory to belief. These assumptions are defeasible in that a speaker can have the reliability of her memory challenged.

The following steps apply Local Givenness to (8).

(8) I don't know why [~~I wasn't scared~~]$_E$, but [I can not remember being scared]$_A$.

[10] I abstract away here from concerns about negative events, and assume that the event in question in (8) exists and that it was either an event of being scared or an event of being not scared. Another way to approach this is to say that the speaker either remembers the event *e* or remembers the maximal eventuality *S* of all eventualities e' in the relevant time period and $e \nsubseteq S$ (cf. Krifka (1989) and de Swart (1996), in which the following definition of event negation is used: $\lambda P.\lambda s.[\mathrm{MAX}(s) \wedge \neg \exists e[P(e) \wedge e \subseteq s]]$).

i. Starting Context:
$c = W$

ii. The presupposition associated with A is that the speaker has a memory of the particular event being discussed, namely an event of being scared or being not scared.

Presupposition of A:[11]
$[\forall w[w \in W_{MEM,s} \rightarrow \exists e[\neg \mathbf{scared}(s)(e)(w)]] \vee \forall w[w \in W_{MEM,s} \rightarrow \exists e[\mathbf{scared}(s)(e)(w)]]]$

iii. The semantics of A expresses that the speaker does not remember an event of being scared: in all the worlds compatible with the memory of the speaker there was no event (in the relevant time period) in which the speaker was scared. $W_{MEM,s}$ here acts as an information state of the speaker containing all those worlds compatible with the memory of the speaker.

Semantic Denotation of A:
$[\![A]\!]^{w,g} = \forall w[w \in W_{MEM,s} \rightarrow \neg \exists e[\mathbf{scared}(s)(e)(w)]]$

iv. Steps (ii) and (iii) together entail the proposition that the speaker remembers an event of his being not scared. Therefore, an assertion of A expresses the following:

Presuppositionally-enriched Denotation of A:
$\forall w[w \in W_{MEM,s} \rightarrow \exists e[\neg \mathbf{scared}(s)(e)(w)]]$

v. Under the inference that the speaker's memories of the past represent the speaker's beliefs about the history of the actual world, we can infer the following from Step (iv).

Inference of Speaker's Belief:
$\forall w[w \in W_{DOX,s} \rightarrow \exists e[\neg \mathbf{scared}(s)(e)(w)]]$

vi. Step (v) pragmatically asserts that the speaker was not scared.[12] The context is then updated with this proposition.

Context Update:
$W \cap \{w: \exists e[\neg \mathbf{scared}(s)(e)(w)]\} = \{w: \exists e[\neg \mathbf{scared}(s)(e)(w)]\} = c_{LE}$

vii. Existential Closure of E:
$ExClo([\![E]\!]^{w,g}) = \{w: \exists e[\neg \mathbf{scared}(s)(e)(w)]\}$

viii. Local Givenness:
$c_{LE} \subseteq E = \{w: \exists e[\neg \mathbf{scared}(s)(e)(w)]\} \subseteq \{w: \exists e[\neg \mathbf{scared}(s)(e)(w)]\}$

[11] Contextual domain restriction assumed throughout.

[12] One could also argue that the assertion creates a subordinating context for the embedded *why* question. I see no crucial difference between the two implementations here.

The existential closure of E is entailed by its local context, and we correctly predict felicitous elision of E.

As a closing note, the fact that example (8) is a cataphoric sluice was ignored for our purposes here. Something must, of course, be said about these sluices, which are common in the Santa Cruz sluicing corpus. I leave this aside for further investigation, besides noting that these sluices seem to involve some sort of processing hold in which the sluice is not interpreted until a relevant antecedent is encountered, analogous to instances of pronominal cataphora.

3.3. Polarity reversals with exclusive disjunction

The resourceful reader might at this point object that, instead of jettisoning our familiar bidirectional entailment account, a simpler path is to simply enrich the bidirectional entailment condition to include pragmatic and not merely semantic content. I show here that a pragmatically enriched bidirectional entailment account still fails to generate the full range of polarity reversal data. The polarity reversal examples discussed in this section involve exclusive disjunction. A corpus example is given in (14) and a constructed example in (15).

(14) [corpus example 22987, Santa Cruz Ellipsis Project]
Context: On Dec. 10, [Senator] McCain sent a letter to the FCC urging the five-member board to end two years of deliberations and decide whether Paxson Communications should be given a license for a Pittsburgh station. Angela J. Campbell, an attorney for opponents to the deal, told the Globe that McCain's letter likely 'tipped' the scales in favor of the decision.

Sluice: "Senator McCain said, 'Do it by December 15 or explain why [~~you didn't do it by December 15~~],' and the commission jumped to it and did it that very day," Campbell told the Globe.

(15) [constructed example]
Context: Students in a semantics class were given the option to do an extra credit problem, and were required to mark the number of the problem that they did on a spreadsheet accessible by the course's professor and TA. Both the professor and TA thought that John, a student in the class, would have chosen to do a problem. They look at the spreadsheet and see that nothing is marked down under John's name. The TA says to the professor:

Sluice: Either [John$_j$ didn't do an extra credit problem]$_A$, or he$_j$ didn't mark which one$_i$ [~~he$_j$ did t_i~~]$_E$.

Note that these examples illustrate that negation can be either "added" into the ellipsis site, as in (14), or "deleted" from the ellipsis site, as in (15).[13]

[13]Thank you to Jason Merchant (p.c.) for pointing out that these data run counter to the claim made in Merchant (2013: 15) that negation present in the antecedent of a sluicing construction requires a corresponding negation present in the ellipsis site.

I focus here on example (15), the utterance of which asserts that either (A) *John didn't do an e.c. problem* or (E) *John did an e.c. problem*. The disjunction is exclusive because the two disjuncts are opposites: they cannot both be true (or false) at the same time. The analysis of (15) given here relies on Karttunen's (1974) proposal of the local contexts for exclusive disjunction constructions. Specifically, Karttunen gives the following asymmetric proposal for disjunctive constructions:

Karttunen's Local Context for Exclusive Disjunction:
For propositions p, q such that $p \vee q$ is uttered in a context c:
c_L for $p = c$,
c_L for $q = c + \neg p$.

The proposal says that the local context for the first disjunct of an exclusive disjunction construction—that is, the context in which the disjunct can be felicitously uttered—is the global conversational context. The local context for the second disjunct is the global conversational context intersected with the negation of the first disjunct. The intuition for this proposal is that for an exclusive disjunction to be true one of the disjuncts must be true, but not both. Therefore, the context in which the first disjunct is admitted is just the global conversational context, but the context in which the second disjunct is admitted takes into account its opposition to the first disjunct, and so all the worlds in which the first disjunct holds are excluded.

The following steps apply Local Givenness to the disjunction in (15).

i. Starting Context:
$c = W$

ii. Denotation of A:
$[\![\mathrm{A}]\!]^{w,g} = \{w{:}\neg\,\exists x[\textbf{extra credit problem}(x)(w) \wedge \textbf{do}(x)(\mathrm{j})(w)]\}$

iii. Denotation and Existential Closure of E:[14]
$ExClo([\![\mathrm{E}]\!]^{w,g}) = \{w{:}\ \exists x[\textbf{extra credit problem}(x)(w) \wedge \textbf{do}(x)(\mathrm{j})(w)]\}$

iv. Karttunen's Local Context for A and E:
$\mathrm{c_{LA}} = \mathrm{c} = \mathrm{W}$

v. Local Givenness:
$\mathrm{c_{LE}} \subseteq ExClo([\![\mathrm{E}]\!]^{w,g}) = \{w{:}\neg\neg\,\exists x[\textbf{extra credit problem}(x)(w) \wedge \textbf{do}(x)(\mathrm{j})(w)]\}$
$\subseteq \{w{:}\ \exists x[\textbf{extra credit problem}(x)(w) \wedge \textbf{do}(x)(\mathrm{j})(w)]\}$

[14]Note that the wh-phrase *which one* is d-linked in the sense of Pesetsky (1987), meaning that it ranges over a salient set in the discourse. One could assume here, following Cinque (1989), that d-linked wh-phrases are referential and therefore leave behind a referentially indexed trace. Existentially closing over this trace would then restrict the possible identity of the thing to which the existentially bound variable can refer to a member of a particular set present in the discourse. However, as the d-linking is orthogonal to the example here, I suppress this issue for the sake of expositional clarity.

Local Givenness is satisfied in step (iv) because the local context for E entails the proposition expressed by E, assuming a classical logic in which a doubly negated proposition equals its unnegated equivalent. We therefore correctly predict felicitous elision of E.

The possibility of polarity reversal sluices in disjunction constructions illustrates the necessity of local contextual entailment in the current account. The global context of (15) does not entail the proposition that John did any extra credit problems, as both possibilities—of John having done extra credit problems and of him not having done any—are being entertained as possibilities. It is only in the local context of the second disjunct that the proposition that John did extra credit problems is entailed, as the local context excludes those worlds in which John didn't do any extra credit problems. Furthermore, examples such as (15) show that a pragmatically-enriched bidirectional entailment account is insufficient to explain the polarity reversal data, as no pragmatic enrichment of the semantic content of A and E in (15) will yield bidirectional entailment of the propositions. Instead, the crucial licensing factor in this example is the disjunctive operator—which contributes its heritage properties[15] to A and E—and not the propositional content of A and E themselves.

4. Concerns of overgeneration

The analysis proposed here is necessarily more permissive than syntactic or semantic entailment accounts of sluicing; this additional permissiveness is required in order to capture the structural and semantic differences between the antecedent and elided phrases in polarity reversal sluices. However, there are concerns that a pragmatics-based sluicing account will overgenerate or be overly permissive. I sketch here several constraints to alleviate these concerns.[16]

First, I adopt the constraint that focus-marked constituents cannot be elided (Rooth 1992; Heim 1997; Merchant 2001). Second, I adopt what I call the Well-Formedness Condition on Sluicing (see Dayal and Schwarzschild 2010):

> *The Well-Formedness Condition on Sluicing*:
> If a pre-sluice is infelicitous, then the corresponding sluice will not be well-formed.[17]

Dayal and Schwarzschild propose the restriction in order to rule out cases such as (16), comparable to (3) above, which motivate the bidirectionality condition of e-GIVENness:

(16) Abby$_i$ called Brian an idiot, but I don't know who [#~~she$_i$ insulted *t*~~]$_E$.

The Condition is both empirically supported and intuitively satisfying. It seems desirable that a question that is infelicitous when uttered overtly will remain infelicitous when partially elided. By adopting the Well-Formedness Condition we are able to rule out examples like

[15] See Karttunen and Peters (1979), Heim (1983), and Kadmon (2001).

[16] See a more extensive discussion of overgeneration concerns in Kroll (in prep). Additional concerns with a pragmatic approach are case matching facts (Merchant 2001) and the Chung's Generalization facts (Chung 2006, 2013). Case matching facts are captured in this account's adoption of Merchant's PF deletion account (2001); see Kroll (in prep) for an account of the Chung's Generalization facts.

[17] The term *infelicitous* was chosen here in order to allow for the proposed amelioration of islands under sluicing (Merchant 2001).

(16) independently, obviating the need for a stronger bidirectional entailment condition in these cases.

A question naturally raised at this point is why the pre-sluices of examples like (16) are infelicitous. I propose that this is because it is infelicitous to ask a question that already has a partial answer available in the discourse (Romero 1997; Fitzpatrick 2005; Barros 2014; a.o.).[18] [19] For example, B's question in (17) is infelicitous without the inclusion of *other*:

(17) A: I saw some tigers today at the zoo.
B: {What/which} #(OTHER) animals did you see today at the zoo?[20]

B's response is infelicitous without *other* because A has already asserted that she has seen some tigers that day at the zoo, which is a partial answer to the question 'What animals did you see today at the zoo?'. *Other* contributes a presupposition that A has seen *some* particular animal at the zoo that day. Unlike previous discussions of this discourse requirement on questions, I propose that the behavior be accounted for using Heim's (1991) *Maximize Presupposition*:

> *Maximize Presupposition*:
> Given two contextually equivalent alternatives, speakers must use the alternative whose presuppositions are stronger and happen to be met in the context of use.

Maximize Presupposition captures exactly the generalization that we want, which is that a question must ask for only new information in a discourse and must presuppose the existence of any partial answers that are already available. The additional benefit of using Maximize Presupposition is that it relates this characteristic of questions to a more general constraint on felicitous utterances in a discourse, making it unnecessary to posit a separate constraint purely for questions.

Last, I integrate into the current account an intuitively satisfying pragmatic constraint that for a proposition to be elided it must be *uniquely salient* at the time the sluice is uttered. The idea is motivated by the common sense principle that in order for a speaker to felicitously not pronounce some part of an utterance, the meaning of the unpronounced piece of the utterance must be recoverable by the speaker's interlocutor in the discourse. The integration of this constraint correctly rules out the infelicitous sluice in (18), which is not ruled out by Local Givenness as given in §3 nor by the Well-Formedness Condition.

(18) [Abby called $[\text{Joe}]_F$ an idiot]$_A$, but I don't know who $[\text{else}]_F$ [#~~Abby insulted~~]$_E$.

The saliency constraint is integrated into the final version of Local Givenness, provided below.

[18]See also Barker's (2013) Answer Ban and Ginzburg's (2012) Question Introduction Appropriateness Condition. While the Answer Ban is intended to apply to sluices, this is clearly a more general constraint on questions in a discourse. The QIAC deals with the resolution (complete answers) of questions in the discourse.
[19]I assume here a definition of partial answers based on partition semantics (Groenendijk and Stokhof 1981, 1984; Lahiri 2002, a.o.).
[20]Where *animals* is given a kind reading, so the relevant alternatives are tigers, lions, llamas, etc.

> **Local Givenness (Final):** A TP α can be deleted iff $ExClo(⟦\alpha⟧^g)$ expresses a proposition p, such that $c_L \subseteq p$ and p is uniquely salient.

Additionally, the following test of saliency is proposed:

> **Test for saliency:** p is salient at time t if p can be picked out by a propositional discourse anaphor, such as *that*, at time t.

That positive polarity sentences license the propositional discourse anaphor *that* is pointed out in Webber (1988), among others. That negative sentences also license discourse anaphora is observed in Asher (1993), Hwang (1992), and de Swart (1996):

(19) John didn't know$_i$ the answer to the problem. This$_i$ lasted until the teacher did the solution on the board. [Asher, pg. 53]

The propositional discourse anaphor *that* is anaphoric to "activated" entities in the sense of Gundel et al. (1990); that is, it is anaphoric to entities that the speech participants are currently aware of, i.e. have access to due to the entities' presence in the immediate discourse context. Note that this type of anaphoric reference to the sluiced content is possible in the polarity reversal cases:

(20) A: I don't know why [~~I wasn't scared~~]$_i$, but I really can not remember being scared.
B: That$_i$'s impossible! You were just a child.

In (20), the deictic demonstrative *that* is anaphoric to the sluiced proposition *I wasn't scared*. That is, the meaning of the first sentence in B's utterance is "It's impossible that you weren't scared."

The strong claim that anaphoric reference with *that* is a necessary and sufficient condition to test the salience of a proposition in all cases is not being advocated here. Salience is a more complicated notion than can be captured in a single test, as the extensive literature on pronominal salience and reference attests. The anaphora test is merely intended to be one way to probe this issue. The larger question of how to determine the saliency of a proposition in a given discourse requires more thought and investigation than space allows here.[21]

5. Conclusion

Polarity reversal sluicing data present a new challenge to the enterprise of determining the conditions under which linguistic content can be felicitously elided. This paper shows that, counter to its dominant treatment in the syntactic literature, ellipsis is an inherently pragmatics-sensitive phenomenon subject to contextual licensing. I argue that the ability to elide linguistic content fits naturally into general theories of constraints regulating coherent discourses, and have detailed one way to account for the pragmatic sensitivity of data that

[21]Note that the claim here is that the sluiced proposition licenses the anaphora; the antecedent material may contribute a discourse referent equivalent to the pragmatically enriched proposition, but the theory here does not predict that it necessarily does.

present serious challenges for non-pragmatic theories. Many challenges to developing a complete theory of sluicing and ellipsis, of course, remain.

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Common nouns as variables: Evidence from conservativity and the temperature paradox[1]

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Abstract. Common nouns and noun phrases have usually been analyzed semantically as predicates. In quantified sentences, these predicates take variables as arguments. This paper develops and defends an analysis in which common nouns and noun phrases themselves are treated as variables, rather than as predicates taking variables as arguments. Several apparent challenges for this view will be addressed, including the modal non-rigidity of common nouns. Two major advantages to treating common nouns as variables will be presented: Such an analysis predicts that all nominal quantification is conservative, rather than requiring conservativity to be stipulated as a constraint on determiner denotations; and it makes possible some improvements to the analysis of the temperature paradox, allowing for quantificational examples without adding a spurious layer of modal variability.

Keywords: common nouns, variables, rigidity, conservativity, temperature paradox

1. Introduction

Common nouns are frequently analyzed semantically as predicates. Beginning logic students are trained to represent sentences like (1)a. using formulas like (1)b., in which the 1-place predicate M seems to correspond directly to the common noun *man*, just as the 1-place predicate S corresponds to the verb *smiles*:

(1) a. Every man smiles.
    b. $\forall x[M(x) \rightarrow S(x)]$

M and S here are syntactically and semantically similar in every way: Both combine with an argument to form a formula; both are the sort of thing which can be truthfully or falsely predicated of an individual; and therefore both are naturally analyzed as denoting the set of individuals of which they can be truthfully predicated (or almost equivalently, the characteristic function of this set).

Montague (1973) treated common nouns as belonging to logical type $\langle\langle s, e\rangle, t\rangle$ — that is, as 1-place predicates of "individual concepts." Following Bennett (1975), most subsequent literature in the Montague-derived tradition (including major textbooks such as Dowty, et al. (1981), Gamut (1991), Heim and Kratzer (1998) and many others) has analyzed them as belonging to type $\langle e, t\rangle$ — as 1-place predicates of individuals. In both approaches, common nouns are treated identically to intransitive verbs. Exceptions are sometimes made for relational nouns such as *mother*, *brother*, *top*, *bottom*, etc., which are then treated as being of type $\langle e, \langle e, t\rangle\rangle$; but this still gives such nouns the status of predicates — just 2-place predicates rather than 1-place.

[1] This paper was presented to the Harvard Linguistics Circle and at the University of Chicago in addition to Sinn und Bedeutung. Thanks to the audiences at both talks, and especially to Nicholas Asher, Gennaro Chierchia and Uli Sauerland for comments and suggestions.

Proper names, in contrast, are most often treated as being of type *e*. That is, each proper name is analyzed in such a way that it denotes some particular individual, rather than "holding true" of all the individuals in some class. This results in a sharp division of semantic function with proper names on one side but verbs and common nouns together on the other. This division is preserved even in most analyses which do not treat proper names as individual-denoting — for example by assimilating proper names to quantifiers, as in Russell's (1910) theory of proper names as "disguised definite descriptions" or in more modern treatments of names and quantifiers as second order predicates (whether of type $\langle\langle e, t\rangle, t\rangle$ or Montague's more baroque $\langle\langle s, \langle\langle s, e\rangle, t\rangle\rangle, t\rangle$).

Occasionally, proper names have been analyzed as predicates (Quine (1960), Fara (2015)), but then, of course, common nouns are treated as predicates too: verbs, common nouns and proper names are all treated similarly, with no clear semantic correlate to the morphosyntactic distinction between verbs and nouns (whether proper or common).

What I will argue in this paper is that common nouns are similar in semantic type to proper names, and differ in type from verbs. The morphosyntactic distinction between nouns and verbs thus corresponds directly to a difference in semantic type. More particularly, I will argue that common nouns are *variables*, in roughly the same sense as the variables of predicate logic. *Man* is more like the *x* in (1)b. than the *M*.

This is not an entirely new idea. Lepore and Ludwig (2007), for example, say "In 'All men', 'men' functions as if it were a variable restricted to taking on as values only men…" But this suggestion appears only in their informal discussion. In their formalization, common nouns are not treated this way — or analyzed at all, really: Lepore and Ludwig give formalized rules only for interpreting a simplified artificial version of English which does not contain sentences like (1)a. but only predicate-logic-like formulas such as (2):

(2) [Every x : x is a man](x smiles)

No interpretation rule is given for the single word *man* (or any other common noun), but only for the whole open formula 'x is a man'. If any semantic analysis of the single word *man* is intended, it is not made explicit; and the notation here, with separate elements 'x' and 'man', does not suggest that the noun itself is a variable, despite Lepore and Ludwig's informal discussion.

To my knowledge, the idea that common nouns are variables has never been developed or defended in detail.[2] The idea faces a number of technical and theoretical challenges: How can we deal with relational nouns? With mass nouns? With quantification? With intensionality? Can such an analysis be made compositional? Even if all these challenges are met, is there any *advantage* to treating common nouns as variables, or does this idea turn out to be equivalent (or inferior) to a treatment of common nouns as predicates?

[2] Aside from Ludwig and Lepore, an interesting comparison may be made to Luo (2012). The idea that common nouns are variables is also, I suspect, the motivating intuition behind Breul (2013), but I must confess an inability to make sense of Breul's formalism.

I think that each of these challenges can be answered, and that there are in fact several advantages to treating common nouns as variables, over treating them as predicates. Showing this in detail is a larger project than can be presented in this short paper, so I will focus here on meeting just one of the "challenges" and two of the "advantages." Specifically, I will show how we can reconcile an analysis of common nouns as variables with the fact that typical common nouns are modally non-rigid; and I will argue that such an analysis predicts that all nominal quantification is conservative, so that conservativity does not need to be stipulated as a condition on determiner denotations; and that it makes possible some improvements to the analysis of the temperature paradox, allowing for quantificational examples without adding a spurious layer of modal variability.

2. First pass: Common nouns as variables

What does it mean to say that common nouns are variables? This will depend on exactly what a "variable" is, of course. Unfortunately, there is no universally agreed-on, standard definition of variables, so our main thesis is somewhat obscure at the outset. We shall therefore have to begin with a technique for the semantic analysis of variables which I think most readers will at least find familiar, and show how common nouns can be treated as variables using this technique. In the end, I will adopt a somewhat different approach to the semantics of variables; but starting with a more familiar technique should at least clarify the intuition underlying the claim that common nouns are variables.

In this familiar technique, expressions are assigned denotations relative to a series of parameter values, including an *assignment of values to variables*. Semantic rules are given in such a way that one can derive equations of the form in (3), where α is a linguistic expression, g is an assignment of values to variables, and the three dots abbreviate whatever other parameters denotations are relativized to:

(3) $[\![\alpha]\!]^{\ldots,g} = a$

Variables are expressions whose denotations are fixed directly by the assignment of values to variables. That is, α is a variable iff for all g (and all ways of filling in the three dots):

(4) $[\![\alpha]\!]^{\ldots,g} = g(\alpha)$

Variable *binding* is analyzed as the assignment of denotations relative to a given assignment g based on denotations relative to assignments which agree with g in what they assign to all variables other than the one being bound.[3] For example, we can define standard variable binding operators like ∀ and ∃ as in (5):

(5) a. $[\![\forall\alpha\varphi]\!]^{\ldots,g} = 1$ iff $[\![\varphi]\!]^{\ldots,h} = 1$ for all h agreeing with g on all variables other than α.
b. $[\![\exists\alpha\varphi]\!]^{\ldots,g} = 1$ iff $[\![\varphi]\!]^{\ldots,h} = 1$ for at least one h agreeing with g on all variables other than α.

[3] This phrasing does not imply that the relevant assignments differ from g in what they assign to the variable being bound. Any assignment g agrees with itself on all variables other than α (for any variable α).

With this understanding of what variables and binding are as background, how can we treat common nouns as variables?

Instead of giving lexical stipulations like those in (6), we may specify the meanings of common nouns as part of the definition of an assignment of values to variables, as in (7):

(6) a. ⟦*student*⟧ = λ*x* . *x* is a student
a. ⟦*professor*⟧ = λ*x* . *x* is a professor

(7) *g* is an *assignment of values to variables* iff
a. *g* is a function with domain {*x* | *x* is a common noun token[4] or …};
b. If α is a token of *student*, then g(α) is a student;
c. If α is a token of *professor*, then *g*(α) is a professor;
d. etc.

It should be noted that under (7), *student* and *professor* are of type *e*, not ⟨*e*, *t*⟩.

We shall have to revise the definition in (7) several times before the end of this paper; but let us adopt it for the moment, and explore how it may function in a larger theory of quantification and binding for English.

I assume that LF representations are derived via an operation of Quantifier Raising, which adjoins a quantifier phrase to its scope, leaving a trace in its original position. I will also assume here that Quantifier Raising is clause-bounded. This means we normally cannot use it to obtain transparent readings for quantifier phrases in opaque contexts; but alternative techniques are available, and perhaps better motivated anyway.[5]

By the *antecedent* of a trace, let us mean the NP of the DP whose trace it is. That is:

(8) Where δ is a determiner token and κ is a common noun phrase token: antecedent(trace(δ κ)) = κ.

Note that this is a slightly non-standard use of the term *antecedent*. In [*every professor* [*e smiles*]], *professor*, not *every professor*, is the antecedent of *e*. We do not assume that traces are co-indexed with their antecedents (or with the DPs containing their antecedents). The analysis is compatible with such co-indexation, but does not require it, provided there is some way of identifying the antecedent of each trace.

Traces will be interpreted as variables, with a requirement that (relative to any assignment of values to variables *g*) a trace co-denotes with its antecedent:

(9) *g* is an *assignment of values to variables* iff
a. *g* is a function with domain {*x* | *x* is a common noun token, trace token or…};
b. If α is a token of *student*, then *g*(α) is a student;
c. If α is a token of *professor*, then *g*(α) is a professor;

[4] Instead of assigning values to expression tokens, we could assign values to pairs of an expression type and a context of use. In the long run, this may be the preferable option; but a consideration of the issue here would force a long digression from our central concerns in this paper, so I assign values to tokens here in the interest of simplicity.
[5] See, e.g., Cresswell (1990).

d. etc.;
e. If ε is a trace token, then $g(\varepsilon) = g(antecedent(\varepsilon))$.

We write "$g \sim_\kappa h$" to mean that assignment h agrees with assignment g on all common noun phrases other than κ. Now we can define *every* syncategorematically:

(10) $[\![every\ \kappa\ \varphi]\!]^g = 1$ if $\forall h\ [g \sim_\kappa h \rightarrow [\![\varphi]\!]^h = 1]$;
0 if $\exists h[g \sim_\kappa h\ \&\ [\![\varphi]\!]^h = 0]$.

It is easy to confirm that this gives the correct result that *Every professor e smiles* is true iff for every x such that x is a professor, x smiles. Other quantifiers can be defined analogously (but revisions will be necessary to deal with more complex cases).

It is perhaps worth noting at this point that if we analyze quantification in the way just sketched, there is no semantic motivation any more to have QR move whole DPs, rather than just determiners, or to have QR leave traces. We could get the same effect simply by moving the determiner, and leaving the NP in situ. But let us leave that issue aside, in order to concentrate on semantic matters rather than syntax.

3. First advantage: Conservativity is predicted

Even though our analysis is not in its final form, we can already see one advantage to treating common nouns in this way, rather than treating them as predicates: The analysis predicts that all nominal quantification is conservative.[6]

This claim must be clarified, because the relevant notion of conservativity here is not exactly the traditional textbook sense. The standard definition is in (11):

(11) D is conservative iff for all A, B: D(A, B) iff D(A, A∩B)

But if we take D to be a determiner denotation, A to be a common noun phrase denotation, and B to be a predicate denotation, this definition presupposes that common nouns denote sets. Analyses which treat common nouns in some other way will *never* claim that determiners are conservative in exactly this sense. In order to compare theories, we need a more general notion of conservativity, which is not tied so tightly to a particular approach to the analysis of common nouns and determiners.

A more useful way to conceptualize conservativity for our current purposes is to recognize that the intuitive content of the standard definition is that A functions as a *domain of quantification*. That is, in ascertaining whether D(A, B), one need not consider those members of B which are not in A. Put differently (and more sloppily and English-specifically): in determining the truth value of a sentence of the form D N VP, you only need to consider the N's: Which N's does VP apply to and which N's doesn't VP apply to? You never need to consider the truth value that results from applying VP to something which isn't an N.

[6] The suggestions made in this section may be interestingly compared to proposals like those in Fox (2002), Sauerland (2004), Sauerland (2007), Romoli (2015); but such a comparison will have to wait for another occasion.

In any analysis, some distinction must be drawn between the things which a given noun accurately describes and those which it doesn't. If common nouns are analyzed as denoting sets, these are the members of the set denoted by the noun; if common nouns are analyzed as denoting functions of type $\langle e, t\rangle$, these are the things mapped onto 1 by the function denoted by the noun; if common nouns are analyzed as variables, these are the things assigned to the noun by the various assignments of values to variables. No matter which approach is taken, a theory claims that determiner quantification is conservative iff whenever a determiner-noun combination combines with a predicate *P* to form a sentence, the truth value of that sentence can be ascertained by considering only how *P* applies to the things accurately described by the noun, so that the truth values which result from applying *P* to things not accurately described by the noun are irrelevant.

Now we can see how conservativity falls out from the general approach to determiner quantification just outlined. Assignments of values to variables, in this approach, are functions from common noun phrases (and traces) to individuals. For any such function, the individual assigned to a given noun N is something which "is an N" — something which would be a member of the extension of N in a more conventional analysis. As one considers a class of assignments which differ from one another at most in what they assign to N, therefore, one is effectively considering the things which are accurately described by the noun. As long as object-language quantification over individuals is analyzed in terms of metalanguage quantification over assignments of values to variables, and as long as determiner-noun combinations are interpreted by quantifying over those assignments which agree on all variables other than the noun with which the determiner combines, conservativity is automatic.

To give just a little more detail: Assume that interpretation rules for quantifiers conform to the following general template, based on the rule for *every*:

(12) $[\![\delta\ \kappa\ \varphi]\!]^g$ = 1 if for δ-many assignments of values to variables h such that $g \sim_\kappa h$, $[\![\varphi]\!]^h = 1$;
= 0 if it is not the case that for δ-many assignments of values to variables h such that $g \sim_\kappa h$, $[\![\varphi]\!]^h = 1$.

Rules conforming to this template derive a value for $[\![\delta\ \kappa\ \varphi]\!]^g$ based on $[\![\varphi]\!]^h$, for various assignments h which differ from g at most in what they assign to κ (and any trace with κ as its antecedent). But $h(\kappa)$ will always be something which is accurately described by κ, and so will $h(\varepsilon)$, where *antecedent*(ε) = κ. There simply *are* no assignments of values to variables relative to which ε receives a value which is not accurately describable by κ, so it makes no sense to ask whether the truth value of φ is relative to such assignments is relevant to the truth value of the whole sentence [δ κ φ].

That is, quantification is just over those individuals which are accurately described by the noun, which is to say, the quantification is conservative — and this follows from the general architecture of the theory. In contrast, if we assume simply that determiners denote 2-place relations between sets (or functions of type $\langle\langle e, t\rangle, \langle\langle e, t\rangle, t\rangle\rangle$), nothing guarantees conservativity; it must be independently stipulated.[7]

4. Adding intensionality: Non-rigid variables

Analyzing common nouns as variables will not work properly in an intensional semantics, if we treat variables in the traditional way. Standard versions of intensional logic and quantified modal logic incorporate a principle like that in (13):

(13) If α is a variable, then $[\![\alpha]\!]^{M,w,g} = g(\alpha)$.

This gives the effect that for all w, w', $[\![\alpha]\!]^{M,w,g} = [\![\alpha]\!]^{M,w',g}$. That is, variables are modally rigid. But now recall (9)b.: "If α is a token of *student*, then $g(\alpha)$ is a student." In which world must $g(\alpha)$ be a student? Since no world is mentioned, we standardly assume the condition is meant to apply in the *actual* world $w_@$. Since variables are rigid, this gives the effect that for any w, $[\![student]\!]^{M,w,g}$ is a student in $w_@$ — but nothing requires $[\![student]\!]^{M,w,g}$ to be a student in w. This is obviously wrong — it results in incorrect truth conditions for sentences like (14):

(14) *John believes that every student e smiles*

Assuming our current semantics including (9), (10) and (13), combined with a standard possible-worlds analysis of *believe* along the lines of Hintikka (1969), (14) is assigned a reading which is true (in the actual world $w_@$) iff in every world w compatible with John's belief state (in $w_@$), everyone who is a student in $w_@$ smiles in w. It is not assigned a reading which is true (in $w_@$) iff in every world w compatible with John's belief state (in $w_@$), everyone who is a student in w smiles in w. In other words, the analysis wrongly predicts that all common nouns should be interpreted transparently.

To allow opaque readings, we need to allow *modally non-rigid variables*.[8] This requires us to revise our definition of an assignment of values to variables:

(15) g is an assignment of values to variables iff
  a. g is a partial[9] function with domain $\{x \mid x$ is a common noun token, trace token or…$\} \times W$;
  b. If α is a token of *student*: for all w, if there exists an x such that $x = g(\alpha, w)$, then $g(\alpha, w)$ is a student in w;
  c. If α is a token of *professor*: for all w, if there exists an x such that $x = g(\alpha, w)$, then $g(\alpha, w)$ is a professor in w;
  d. etc.;
  e. If ε is a trace token, then for all w, $g(\varepsilon, w) = g(antecedent(\varepsilon), w)$.

[7] Our discussion in this section raises the question of how to deal with *only* and other quantifiers which appear not to be conservative. I assume in such cases, the quantifier binds a variable which is constructed in part based on intonational focus or other factors, rather than simply binding the NP (if any) which serves as its syntactic complement. That is, the quantification in such cases is not strictly "nominal." A detailed consideration of such cases will have to await another occasion.
[8] These have rarely been suggested before, but see e.g. Hughes and Cresswell (1968: 195–201).
[9] We allow g to be a partial function because in some worlds, there aren't any students or professors.

Making this change necessitates corresponding revisions to our definition for the double brackets, and to our definition of what it means for one assignment to agree with another on all values other than a particular one:

(16) If α is a variable, then for all worlds w and assignments g: $[\![\alpha]\!]^{w,g} = g(\alpha, w)$.

(17) $g \sim_{\kappa,w} h$ iff
  a. there exists some x such that $h(\kappa, w) = x$; and
  b. for all common noun phrases ν and worlds w': if $\nu \neq \kappa$ then $g(\nu, w') = h(\nu, w')$.

We also need to revise our rule for *every* to reflect the change made in (17):

(18) $[\![\textit{every}\ \kappa\ \varphi]\!]^{w,g} = 1$ if $\forall h\,[g \sim_{\kappa,w} h \rightarrow [\![\varphi]\!]^{w,h} = 1]$;
0 if $\exists h[g \sim_{\kappa,w} h\ \&\ [\![\varphi]\!]^{w,h} = 0]$.

It is easy to confirm that our rules now give the desired modal profile for sentences like *Every student e smiles*.

However, our revisions have introduced another problem. Some variables *should* be rigid — specifically *pronouns*, assuming these can be bound across the borders of intensional contexts.

For example, consider (19), assuming that *professor* is the antecedent of *she*.

(19) [*Every professor e believes* [*that she smiles*]]

If we treat the pronoun here the way we have treated traces — as codenoting, in each world w, with its antecedent — we assign the wrong truth conditions. Intuitively, (19) is true in $w_@$ only if for every x such that x is a professor in $w_@$, in every world w compatible with x's belief state in $w_@$, x smiles in w. But if we require, for every assignment g, world w and pronoun π, that $g(\pi, w) = g(\textit{antecedent}(\pi), w)$ — like we did with traces — we do not get that reading, because nothing requires that $g(\textit{she}, w) = g(\textit{professor}, w_@)$. Quantifying on assignments that agree with g on all values other than $g(\textit{professor}, w_@)$ will not quantify over values for *she* in the "belief worlds".

To solve this problem, we must again revise our definition of assignment functions, so that each one is keyed to a particular world:

(20) g is an assignment of values to variables for w (or "w-assignment") iff
  a. g is a partial function with domain $\{x \mid x$ is a common noun token, trace token, pronoun token, or…$\} \times W$;
  b. If α is a token of *student*: for all w': if there exists an x such that $x = g(\alpha, w')$, then $g(\alpha, w')$ is a student in w';
  c. If α is a token of *professor*: for all w': if there exists an x such that $x = g(\alpha, w')$, then $g(\alpha, w')$ is a professor in w';
  d. etc.;

e. If ε is a trace token, then $g(\varepsilon, w') = g(antecedent(\varepsilon), w')$;
f. If π is a pronoun token, then $g(\pi, w') = g(antecedent(\pi), w)$.

Note the difference between clauses e. and f. Relative to each world w', a trace is required to denote the same thing as the denotation of its antecedent in w', but a pronoun is required to denote the same thing as the denotation of its antecedent in w, the world to which the assignment is keyed. This guarantees that relative to any given assignment, the denotation of a pronoun is modally rigid.

Now we revise the tilde notation so that agreeing assignments must be keyed to the same world:

(21) $g \sim_{\kappa,w} h$ iff
a. g and h are both w-assignments;
b. there exists some x such that $h(\kappa, w) = x$; and
c. for all common noun phrases ν and worlds w': if $\nu \neq \kappa$ then $g(\nu, w') = h(\nu, w')$.

Our rule for *every* in (18) can remain notationally the same, but operates differently due to the replacement of (17) with (21). In (18), g and h are now both required to be w-assignments — so relative to h, any pronouns in φ will rigidly denote what κ denotes relative to h in w. This ensures that (19) will be true relative to a world w only if for every x such that x is a professor in w, for every w' compatible with x's belief state in w, x smiles in w'. The person who smiles in each professor's belief worlds is correctly required to be that same person who is a professor in w, and holds the belief. There is no requirement that every professor must be a professor in all her belief worlds.

5. Second advantage: The temperature paradox

We can now turn to a second major advantage to treating common nouns as variables: It allows some improvements in how we analyze the temperature paradox. The paradox and its proposed solution in Montague (1973) are familiar to most readers and will only be briefly sketched here: The argument in (22) is of a form which seems naturally representable as in (23), but (23) is a valid argument and (22) is not.

(22) The temperature is rising.
The temperature is 90.
Therefore, 90 is rising.

(23) $\exists x[\mathbf{temperature}(x) \,\&\, \forall y[\mathbf{temperature}(y) \rightarrow x = y] \,\&\, \mathbf{rise}(x)]$
$\exists x[\mathbf{temperature}(x) \,\&\, \forall y[\mathbf{temperature}(y) \rightarrow x = y] \,\&\, x = n]$
$\therefore \mathbf{rise}(n)$

Montague's solution is to treat *rise* as a predicate of functions from indices (including times) to individuals, but treat *is* as holding (at a given index) between two such functions iff they return the same value for that index.[10] Under this analysis, (22) can be paraphrased as (24), which is easily seen as invalid:

(24) The unique temperature function is a rising function.
The unique temperature function and the 90 function currently yield the same value.
Therefore the 90 function is a rising function.

The analysis is made more formal through the use of $^\wedge$- and $^\vee$-operators, defined as in (25) and (26):

(25) $[\![{}^\wedge\alpha]\!]^{M,w,t,g}$ = that function f with domain $W \times T$ such that for all $w' \in W$, $t' \in T$: $f(w', t') = [\![\alpha]\!]^{M,w',t',g}$

(26) $[\![{}^\vee\alpha]\!]^{M,w,t,g} = [\![\alpha]\!]^{M,w,t,g}(w, t)$

Now the argument may be represented as (27) rather than (23):

(27) $\exists x[\mathbf{temperature}(x) \,\&\, \forall y[\mathbf{temperature}(y) \rightarrow x = y] \,\&\, \mathbf{rise}(x)]$
$\exists x[\mathbf{temperature}(x) \,\&\, \forall y[\mathbf{temperature}(y) \rightarrow x = y] \,\&\, {}^\vee x = {}^\vee n]$
$\therefore \mathbf{rise}(n)$

In (27), the variables x and y are of type $\langle s, e\rangle$, not of type e. Hence **rise** and **temperature** must both be of type $\langle\langle s, e\rangle, t\rangle$. In the case of **rise**, this is intuitive and appropriate. What counts as rising at a time t depends on how things are at times other than t. It is impossible to ascertain whether the temperature is rising at a moment by examining a photograph of a thermometer taken at that moment; one needs multiple photographs, taken at different times. It therefore makes sense to treat *rise* as taking functions from times to numbers as its arguments, so that *rise* can "see" what is going on at other times; there is a clear intuitive basis for treating *rise* as temporally intensional.

But the situation with **temperature** is quite different: To tell whether a particular value is the temperature at a given moment, a single photograph taken at that moment suffices, and photographs taken at other times are irrelevant. There isn't the same intuitive basis for letting *temperature* take functions from times to numbers as its arguments as there is for *rise*; *temperature* is not temporally intensional in its conditions of application like *rise* is.

This feature of Montague's analysis leads to a problem pointed out by Anil Gupta.[11] Intuitively, the argument in (28) is valid. But it is translated into Intensional Logic as in (29), and (29) is *not* a valid argument:

(28) Necessarily, the temperature is the price.
The temperature is rising.
Therefore, the price is rising.

[10] I have simplified Montague's analysis here by setting aside some irrelevant complications with type assignment.
[11] Gupta's problem is outlined in Dowty, et al. (1981: Appendix III)

(29) $\Box\exists x[\mathbf{temperature}(x)\ \&\ \forall y[\mathbf{temperature}(y) \to x = y]\ \&\ \exists z[\mathbf{price}(z)\ \&\ \forall y[\mathbf{price}(y) \to z = y]\ \&\ {}^{\vee}x = {}^{\vee}z]$
$\exists x[\mathbf{temperature}(x)\ \&\ \forall y[\mathbf{temperature}(y) \to x = y]\ \&\ \mathbf{rise}(x)]$
$\therefore \exists x[\mathbf{price}(x)\ \&\ \forall y[\mathbf{price}(y) \to x = y]\ \&\ \mathbf{rise}(x)]$

To see that (29) is invalid, let T_1, T_2, T_3, P_1, P_2, P_3 be the functions given in (30). Now consider a model where **temperature** holds at $\langle w_1, t_1\rangle$ uniquely of T_1, at $\langle w_1, t_2\rangle$ of T_2, and at $\langle w_1, t_3\rangle$ of T_3, and where **price** holds at $\langle w_1, t_1\rangle$ uniquely of P_1, at $\langle w_1, t_2\rangle$ of P_2, and at $\langle w_1, t_3\rangle$ of P_3:

(30)

$T_1(w_1, t_1) = 99$	$T_2(w_1, t_1) = 89$	$T_3(w_1, t_1) = 79$
$T_1(w_1, t_2) = 100$	$T_2(w_1, t_2) = 90$	$T_3(w_1, t_2) = 80$
$T_1(w_1, t_3) = 101$	$T_2(w_1, t_3) = 91$	$T_3(w_1, t_3) = 81$
$P_1(w_1, t_1) = 99$	$P_2(w_1, t_1) = 91$	$P_3(w_1, t_1) = 83$
$P_1(w_1, t_2) = 98$	$P_2(w_1, t_2) = 90$	$P_3(w_1, t_2) = 82$
$P_1(w_1, t_3) = 97$	$P_2(w_1, t_3) = 89$	$P_3(w_1, t_3) = 81$

It is easy to see that the first premise of (29) is true: at each world-time pair there is a unique temperature function, and a unique price function, and the two functions return the same current value — 99 at $\langle w_1, t_1\rangle$, 90 at $\langle w_1, t_2\rangle$, and 81 at $\langle w_1, t_3\rangle$. The second premise of (29) is also true at all indices, under an intuitive definition of **rise** and an assumption that t_1 precedes t_2 and t_2 precedes t_3: At each index, the unique temperature function is a rising function, returning a higher value at each successive time. For example, at $\langle w_1, t_2\rangle$ the unique temperature function is T_2, which returns 89 at $\langle w_1, t_1\rangle$, 90 at $\langle w_1, t_2\rangle$, and 91 at $\langle w_1, t_3\rangle$. However, the conclusion of (29) is false at every index, since at every index the unique price function is a falling function, not a rising one.

In Lasersohn (2005) I suggested a solution to this problem, which unfortunately did not work. I argued that the source of the problem was in treating *the* as a variable-binding quantifier. In the sentence *The temperature is rising*, this quantificational analysis of *the* requires *temperature* to take the same variable as its argument as *is rising* does, which in turn forces *temperature* into the intuitively unjustified type $\langle\langle s, e\rangle, t\rangle$, which allows different temperature functions (and not just different temperature values) at different times, which leads to Gupta's problem. But if we switched to a non-quantificational analysis of *the*, I argued, we could avoid using a single variable both as argument to *temperature* and as argument to *is rising*. Specifically, if we represent *the temperature* as ιx **temperature**(x), where **temperature** is of type $\langle e, t\rangle$ and the iota-operator is interpreted as in (31), then *The temperature is rising* can be represented as in (32):

(31) $[\![\iota x\ P(x)]\!]^{M,w,t,g}$ = the unique element u such that $[\![P]\!]^{M,w,t,g}(u) = 1$ if there is such a unique element, undefined otherwise.

(32) $\mathbf{rise}({}^{\wedge}\iota x\ \mathbf{temperature}(x))$

At each index, ιx **temperature**(x) denotes the unique temperature (value) at that index. By the semantics of the ^-operator in (25), $^{\wedge}\iota x$ **temperature**(x) will rigidly denote the function mapping each index onto the unique temperature at that index. In this way, we derive just one temperature function — the same one at every index — and just one price function. Hence, if at every index the temperature function yields the same value as the price function (so they are really the very same function), and the temperature function is a rising function, then the price function must be a rising function too. Gupta's problem is eliminated.

However, this solution cannot be correct, as Romero (2008) was quick to point out. By tying the solution to a non-quantificational analysis of *the*, I made it impossible to deal with more clearly quantificational examples in the same way. But such examples exist; in fact, Montague himself gave such an example, perhaps because he anticipated the kind of analysis I was proposing:

(33) A price rises.
Every price is a number.
Therefore, a number rises.

In light of such examples, I concede the point that the temperature paradox does not really provide us with evidence for a non-quantificational theory of the definite article. Considerations of space preclude a review of Romero's very interesting analysis here, but it should be acknowledged that it accounts successfully for the validity of Gupta's argument.

However, it also retains an odd feature of Montague's original analysis, which seems to me to be very unintuitive: It allows nouns like *temperature* to denote different sets of functions relative to different times. That is, we can have temporal variation not just in what values get returned by the temperature function (or functions), but in which functions count as temperature functions in the first place.

Intuitively, that can't happen. Suppose we are talking about the temperature of one particular object, in one particular world. If at time t_1, the temperature function for that object in that world maps t_1 to 90, t_2 to 91, and t_3 to 92, then it cannot happen that at t_2, the temperature function for that object in that world maps t_1 to 85, t_2 to 84, and t_3 to 83. This kind of temporal variation is easy enough to rule out by meaning postulate (or some similar lexical stipulation), but it would be preferable, if possible, to find a more "architectural" solution, which prevented a case like this from coming up in the first place.

If we analyze common nouns as variables, and allow variables to be temporally non-rigid in the same way as we allowed them to be modally non-rigid, such a solution is available. First, to allow for temporal intensionality, we revise the definition of assignment functions in (20) so that assignments give values to variable-world-time *triples*, and add a clause for the noun *temperature*:

(34) g is an assignment of values to variables for w, t (or "w,t-assignment") iff
   a. g is a partial function with domain $\{x \mid x$ is a common noun token or trace token or pronoun token or $\ldots\} \times W \times T$
   b. If α is a token of *student*: for all w', t': if there exists an x such that $x = g(\alpha, w', t')$, then $g(\alpha, w', t')$ is a student in w' at t';

c. If α is a token of *professor*: for all w', t': if there exists an x such that $x = g(\alpha, w', t')$, then $g(\alpha, w', t')$ is a professor in w' at t';
d. If α is a token of *temperature*: there is some pragmatically relevant object or location x, such that for all w', t': x exists at w', t' iff $g(\alpha, w', t')$ is the temperature of x in w' at t' (in the relevant scale — ˚F, ˚C, etc.)
e. etc.;
f. If ε is a trace token: for all w', t': $g(\varepsilon, w', t') = g(antecedent(\varepsilon), w', t')$;
g. If π is a pronoun token: for all w', t': $g(\pi, w', t') = g(antecedent(\pi), w, t)$.

Notice that according to (34)d., for each assignment function g and token of the noun *temperature* there is one particular object or location whose temperature at various times and worlds is tracked by the values which g assigns to that token (relative to those times and worlds). The value which g assigns to a token of *temperature* relative to a world w and time t is just a number — an entity of type e — not a function or set of functions. So for any given world and any given object, there will be just one function which picks out the temperature of that object in that world at each time — not different such functions at different times. This eliminates the source of Gupta's problem.

In a semantic theory using (34), the intension of a token of *temperature* relative to a given assignment g will naturally be a function mapping each world-time pair onto the temperature of one particular object or location in that world at that time.

Verbs like *rise* must remain at type $\langle\langle s, e\rangle, t\rangle$. But now we have a problem: If traces are required to co-denote with their antecedents, and nouns like *temperature* are type e, then the trace left by phrases like *the temperature* or *every price* will also be of type e, so it will not be of the right type to serve as argument to *rise*. Therefore, we now allow traces (and pronouns) of type $\langle s, e\rangle$. If a trace or pronoun is in position to fill an $\langle s, e\rangle$ argument place, the trace/pronoun must be of type $\langle s, e\rangle$. If it is in position to fill a type e argument place, it must be of type e. If a trace or pronoun is of type $\langle s, e\rangle$, its denotation must be the same as the *intension* of its antecedent, rather than its extension. More formally, we replace (34)f., g. with (35)a., (35)b.:

(35) a. If ε is a trace token: for all w', t': $g(\varepsilon, w', t') = g(antecedent(\varepsilon), w', t')$ or $g(\varepsilon, w', t')$ = that function f: $W\times T\rightarrow\mathbf{D}_e$ such that for all w'', t'', $f(w'', t'') = g(antecedent(\varepsilon), w'', t'')$, according as ε is of type e or of type $\langle s, e\rangle$;

b. If π is a pronoun token: for all w', t': $g(\pi, w', t') = g(antecedent(\pi), w, t)$ or $g(\pi, w', t')$ = that function f: $W\times T\rightarrow\mathbf{D}_e$ such that for all w'', t'', $f(w'', t'') = g(antecedent(\varepsilon), w'', t'')$, according as π is of type e or of type $\langle s, e\rangle$.

Finally, we need to make the obvious updates to the notation used in our rules and definitions, to reflect the fact that assignments are now to a time parameter in addition to a world. We replace (21) with (36):

(36) $g \sim_{\kappa,w,t} h$ iff
a. g and h are both w,t-assignments;
b. there exists some x such that $h(\kappa, w, t) = x$, and

c. for all common noun phrases ν, worlds w' and times t':
if $\nu \neq \kappa$, then $g(\nu, w', t') = h(\nu, w', t')$.

And (18) with (37):

(37) $[\![every\ \kappa\ \varphi]\!]^{w,t,g} =$
1 if $\forall h\ [g \sim_{\kappa,w,t} h \rightarrow [\![\varphi]\!]^{w,t,h} = 1]$;
0 if $\exists h[g \sim_{\kappa,w,t} h\ \&\ [\![\varphi]\!]^{w,t,h} = 0]$.

Now our semantics (unlike that of Lasersohn (2005)) will assign a coherent interpretation to sentences like [*Every temperature* [*e rises*]]. In order to serve as argument to *rises*, the trace *e* must be of type ⟨*s*, *e*⟩. Therefore, relative to any assignment *g*, it must denote the intension of its antecedent, *temperature*, relative to *g*. Relative to *g*, the intension of *temperature* is a function tracking the temperature of one particular object or location — but relative to another assignment, the intension of the *temperature* might be a function tracking the temperature of some other relevant object or location. The sentence is true relative to an assignment *g* iff [*e rises*] is true relative to every assignment *h* agreeing with *g* on all nouns other than *temperature*. That is, it is true if the temperature function of each relevant object or location is a rising function.

The original temperature paradox argument correctly comes out invalid, even if we adopt a quantificational analysis of definites. We may define *the* as in (38):

(38) $[\![the\ \kappa\ \varphi]\!]^{w,t,g} = 1$ if $\exists h[g \sim_{\kappa,w,t} h\ \&\ \forall i\ [g \sim_{\kappa,w,t} i \rightarrow h = i]\ \&\ [\![\varphi]\!]^{w,t,h} = 1]$;
0 if $\neg\exists h[g \sim_{\kappa,w,t} h\ \&\ \forall i\ [g \sim_{\kappa,w,t} i \rightarrow h = i]\ \&\ [\![\varphi]\!]^{w,t,h} = 1]$.

Consider the truth condition assigned to (39) under this rule:

(39) [*The temperature* [*e rises*]]

In order for (39) to be true relative to an assignment *g* (in *w*, at *t*), there must be exactly one assignment *h* which agrees with *g* on all common noun tokens other than the token of *temperature* in this example. If *h* agrees with *g* in this way, there must be some pragmatically relevant object or location, whose temperature *h* assigns to this token at each world and time. Since *h* is unique, there can be only one function which maps a pragmatically relevant object or location onto its temperature at each world and time. That is to say, despite the fact that *temperature* is of type *e*, according to our rules (39) requires a unique temperature *function*, not just a unique temperature *value*. Of course this unique temperature function must also be a rising function in order for (39) to be true.

In contrast, (40) is true (relative to *w*, *t*, *g*) iff the value of the unique temperature function at *w*, *t* is 90; the trace here is of type *e*, and therefore denotes the extension, not the intension of its antecedent.

(40) [*The temperature* [*e is ninety*]]

Assuming that the intension of *ninety* is the constant function mapping each world-time pair onto 90, (41) will always be false, even if (39) and (40) are true:

(41) [*Ninety rises*]

It is also easy to see that Gupta's argument comes out valid. Sentence (42)a. equates, at all world-time pairs, the value of the unique temperature function with the value of the unique price function. If the unique temperature function yields the same value at every pair as the unique price function, then they are the same function; so if the temperature function is rising, the price function is rising.

(42) a. Necessarily, the temperature is the price.
b. The temperature is rising.
c. Therefore, the price is rising.

6. Conclusions

Common nouns which are usually analyzed predicates of type ⟨*e*, *t*⟩ may instead by analyzed as being of type *e* by treating them as restricted variables. Treating them this way, in combination with a standard understanding of what variable-binding is, predicts that all nominal quantification is conservative, and does so without any independent restriction on determiner meanings.

In order to assign correct truth conditions to sentences in which common nouns appear in intensional contexts, an analysis which treats them as variables must allow variables to be modally non-rigid. Certain other variables, notably pronouns, should continue to be analyzed as rigid.

Allowing modally non-rigid variables makes possible an analysis of the temperature paradox which can deal with quantificational examples, without requiring extra stipulations to rule out modal variation in which functions count as temperature functions, thus solving "Gupta's problem."

These arguments are not by themselves sufficient to establish that common nouns should be analyzed as variables. That would be a far larger project, requiring much more thorough and intensive investigation than can be accomplished in a single paper. Several important challenges to this view have not been addressed here: How can we deal with relational nouns? With complex noun phrases containing modifiers? With mass and plural nouns? Can the treatment of quantification be formulated in such a way that determiners are assigned denotations, instead of being interpreted syncategorematically, as they were in this paper? I believe all these challenges can be met; but demonstrating this will have to wait for another occasion.

Additional advantages to analyzing common nouns and noun phrases as variables also suggest themselves: Such an analysis may allow for a closer, more systematic correlation between syntactic categories and semantic types. If complex phrases like *farmers who own a donkey* can be treated as type *e* variables, a new pathway opens for the analysis of the "proportion problem" in sentences like *Most farmers who own a donkey beat it*. Treating common nouns as type *e* variables promises a more natural analysis of "collectivizing" conjunction of common nouns, as in the reading of *this man and woman* where it denotes a group whose members are a man and a woman. These and other topics must here be left to later investigation.

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Bayes nets and the dynamics of probabilistic language

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Abstract. This paper is about a shared concern of linguistic semantics and pragmatics, epistemology, and many other areas of cognitive science: the formal representation of information and uncertainty. It is common in many of these areas, and increasingly in linguistics, to represent agents' information using probability—an enrichment of classical semantics. However, each application of probability must answer difficult questions about whether a probabilistic representation is rich enough to capture the nuances of our information states. Two such problems—the epistemological distinction between uncertainty and ignorance, and the dynamic effects of probabilistic language in formal pragmatics—seem to suggest a negative answer, and to support a more complicated model that repesents uncertainty in terms of *sets of* probability measures. Following insights due to Judea Pearl (1988), I argue that the simplest probabilistic approach may be sufficient to handle these problems if we pay close attention to the *hierarchical* structure of information states, as encoded explicitly in the graphical representation of relationships among questions known as "Bayesian networks" or "Bayes nets".

Keywords: epistemic modality, probability, dynamics, epistemology

1. Three scenarios and two puzzles

(1) Two teams, A and B, are about to compete in a soccer game. You've seen them compete many times, and you are certain that they are evenly matched. What probability should you assign to the sentence "A will win"?

(2) Two teams, A and B, are about to compete at soccer. You know nothing at all about these two teams. What probability should you assign to the sentence "A will win"?

If pushed, most people will give the same answers to these questions: "50%". But our reason for giving these answers is obviously different in (1) and (2). In (1), we have a lot of relevant information to justify making this choice with confidence. In (2), our choice is made in ignorance: we just don't have any reason at all to favor one team over the other. Obviously, there is an epistemologically relevant difference, and it would be a mistake to represent our information identically in (1) and (2). But probabilistic representation seems not to make a distinction here.

(3) As in example (2), there are two teams, A and B, who are about to compete, and you know nothing at all about them. However, a knowledgeable friend assures you that "Team A is likely to win." What probability should you assign to "A will win"?

Here we move from a mainly epistemological question to one that lies at the border of epistemology, formal pragmatics, and computational cognitive science. Epistemologists and psychologists worry about the way that people do (or should) modify their states of information in light of *new information, however acquired*. Formal pragmaticists and dynamic semanticists worry about the way that people do (or should) modify their states of information in light of *new information acquired by linguistic means*. The latter kind of question being a special case of the former, both groups of theorists should care about what information is conveyed by the sincere assertion of a statement with probabilistic import, like “Team A is likely to win”. This is a particularly important problem for theorists of a Bayesian bent, since for them probability—or “credence”—is the basic currency of belief. Unfortunately, there is no general theory of the informational effects of probabilistic language to date. An attempt to frame one must balance three considerations, each difficult in its own right: getting the empirical facts right, integrating with existing accounts of linguistic dynamics, and remaining plausible in light of a broader accounts of epistemology and the cognitive science of learning and reasoning.

This paper treats the dynamics of probabilistic language and the confidence/ignorance distinction as two sides of an epistemological coin. The first approach takes ordinary probability to be inadequate as a representation of agents’ credence states, and opts for a richer model using imprecise credences—i.e., sets of probability measures. Probabilistic language, in turn, is modeled in terms of filtering on this set. The second approach tries to explain both the confidence/ignorance distinction and the dynamic effects of probabilistic language in terms of a single probability model that incorporates a hierarchical structure—such as that of a Bayes net. The need to include hierarchical structure in probabilistic models employs enjoys vast psychological, philosophical, and computational motivation (e.g., Pearl 1988, 2000; Glymour 2001; Sloman 2005; Woodward 2003; Tenenbaum et al. 2011; Danks 2014). Hierarchical models can also be used to model the interplay between statistical and causal reasoning, which is crucial in many linguistic, cognitive, and philosophical applications. There is an obvious gain in theoretical simplicity, then, if we can apply this independently motivated modeling approach to resolve the problems discussed here as well. However, I will argue that the primary motivation for the hierarchical approach is that it yields a better account of the basic empirical facts.

None of this calls directly into doubt whether further phenomena might motivate the use of imprecise probabilities in epistemology, psychology, or linguistics. Nor does it bear on the rather different question of whether imprecise-probability models are useful in modeling epistemic phenomena that extend beyond the minds of individuals, such as group belief or conversational common ground. (See brief comments on the latter in §5 below.) The main claim of the current work is rather that certain phenomena which appear to problematize Bayesian models of individual agents’ informational states and their (linguistic and non-linguistic) dynamics in fact already have an illuminating explanation within these models.

2. Precise and imprecise credences

Say that an agent a has *precise credences* just in case a’s state of information is well-represented by a probability measure P_a. Since this function is being used here to model a’s state of belief, or “credence”, we’ll also call it a “credence function”. P_a assigns a number between 0 and 1 to each proposition $A \in \wp(W)$, subject to the usual laws of probability (Kolmogorov, 1933): $P_a(W) = 1$, and $P_a(A \cup B) = P_a(A) + P_a(B) - P_a(A \cap B)$. (These definitions assume that W is finite, inessentially, in order to simplify the math.) Just what it means for a’s information to be “well-represented” by P_a is a difficult theoretical question that I will leave at an intuitive level here. Explicit judgments about probability, other linguistic behaviors, overt choices, and dispositions to choose in particular ways are some of the many ways that we might want to evaluate whether a candidate P_a is a good representation of a's information. Notice that this model does not compete with classical semantics, but rather *presupposes* and *extends* it: a set of worlds W generates a Boolean algebra $\wp(W)$ whose elements are propositions that receive probabilities. Probability assignments are constrained by classical logic. For example, if A and B are contradictory—$A \cap B = \varnothing$—then $P(A \cap B) = 0$. If A entails B—$A \subseteq B$—then $P_a(A) \leqslant P_a(B)$. (Indeed, the probabilistic model inherits some important limitations of the classical semantics, such as problems around logical omniscience and hyperintensionality.)

Precise credence models have many epistemological and cognitive advantages, and are also subject to many kinds of objections. One well-known objection involves experimental evidence that ordinary people make systematic errors in probabilistic reasoning (e.g., Tversky and Kahneman 1974; Kahneman et al. 1982). While this kind of critique is surely relevant, I want to set it aside here with a few quick comments. First, there are many additional experiments in which people seem to reason appropriately with probabilities. Second, experiments in which people are asked to reason explicitly about probabilities may be less theoretically revealing than those in which probabilistic inference is implicit in the way that uncertainty informs judgment and decision (e.g., Griffiths and Tenenbaum 2006; Trommershäuser et al. 2008). The logic is essentially the same as that which motivates linguists to pay closer attention to unreflective linguistic productions and judgments than to explicit metalinguistic judgments. Third, recent work has suggested a reconciliation, where at least some errors and biases in probabilistic reasoning may be explicable in terms of performance factors, interactions among cognitive systems, or strategies for efficient approximation (Griffiths et al., 2012; Vul et al., 2014).

The objections that motivate imprecise credence models are primarily of a different kind. Kahneman and Tversky argued that ordinary people's credence states, to the extent that they are not consistent with a precise credence model, fail to meet a normatively correct epistemological standard. Proponents of imprecise credences, in contrast, argue that it would in many cases be normatively inappropriate for an agent to have a credence state that is consistent with a precise credence model. A typical example is scenario (2): two teams compete in a game, and you know nothing at all about their relative skills. Joyce (2005, 2010) argues that, in such a scenario, you are making a mistake if you have *any* precise credence in team A winning. What possible grounds could you have for such "extremely definite beliefs ... and very specific inductive policies", when "the evidence comes nowhere close to warranting such beliefs and policies" (Joyce 2010, p.285)? Depending on the teams' relative skills, the right credence to have might be any value in the range $[0,1]$! You don't know enough to exclude *any* of these.

This objection is closely related to the problem of insufficient expressiveness that we began with. When asked for a probability estimate in scenarios (1) and (2), I might produce "50%" in both cases—but confidently in (1), and with hesitation and confusion in (2). Similarly, I would immediately reject an uneven bet on either team in (1), but might have a harder time making up my mind in (2). Either way, the precise model seems to miss at least two important differences between these judgments: differences in their evidential basis, and in their phenomenology. Any two events to which I give credence 0.5 just have credence 0.5, end of story. As a result, precise credences are not fine-grained enough to provide a good model of my credence state. As Halpern (2003, p.24) puts it, "Probability is not good at representing ignorance".

3. Confidence and ignorance: An imprecise model

The proposed alternative is to represent an agent a's information not by a single measure P_a, but by a *set* of measures $\mathbb{P}_a$ (e.g., Levi 1974; Jeffrey 1983). This is sometimes called a's "Representor" (van Fraassen, 1990). Each $P \in \mathbb{P}_a$ conforms to the probability axioms. This model has no expressive difficulty in the sporting examples. In the first scenario, where I am confident that the teams are evenly matched, my $\mathbb{P}$ has the property that, for every $P \in \mathbb{P}$, $P(\text{A wins}) = 0.5$. In the second scenario, where I have no relevant information, my $\mathbb{P}$ has the property that, for every $r \in [0,1]$, there is a measure $P \in \mathbb{P}$ such that $P(\text{A wins}) = r$. In the first case I have an "extremely definite belief" (Joyce, 2010) that $P(\text{A wins}) = 0.5$, and I am right to. In the second I have no definite belief about the value of $P(\text{A wins})$, and I am right not to.

Despite this apparent success, some important objections have been made to the use of imprecise probabilities. One is that it is difficult to frame a plausible decision theory for agents with imprecise credences. Elga (2010), in particular, canvasses a number of options and shows that each makes pathological predictions in certain cases; see also White 2010. A second kind of objection involve examples where imprecise models seem to predict, rather oddly, that learning a new fact should lead to a net loss of information ("probabilistic dilation": Seidenfeld and Wasserman 1993), or where learning something that is intuitively irrelevant to an event A leads to a gain of information about A's probability (White, 2010). (However, see Pedersen and Wheeler 2014 for important subtleties that may help to improve the plausibility of dilation.) These particular objections are two of many, and they are still a matter of active controversy in the epistemological literature. I don't want to take a stand on whether they are decisive, but I do think they give us sufficient reason to look for a model that combines naturally with well-understood, well-behaved Bayesian models of learning and decision. First I will discuss a third objection which introduces some of the motivation for the hierarchical alternative.

Perhaps the most troubling objection to imprecise probability models, from our current perspective, is the observation that they "preclude[] inductive learning in situations of extreme ignorance" (Joyce 2010, p.290; see also White 2010; Rinard 2013). For example, consider a biased coin example analogous to scenario 2 above. Suppose I am uncertain about the probability of getting heads when a certain coin is tossed. This probability could in principle be anywhere in $[0,1]$. On any given toss, the probability of getting heads—$P(\text{heads})$—is equal to the coin's bias π, which is a fixed fact about the world, determined by the coin's objective properties. My uncertainty about $P(\text{heads})$ reduces to uncertainty about the value of π.

Suppose I had precise credences, with a prior distribution on π—say, a Beta distribution. If I wanted to be maximally noncommittal, I might use a $\text{Beta}(1,1)$ distribution, which puts equal prior probability on every bias $\pi \in [0,1]$ (see Fig. 1, left). Given this model, after conditioning on the observation of n heads and m tails my posterior probability is given by $\text{Beta}(1+n, 1+m)$. (In general, conditioning a $\text{Beta}(a,b)$ prior on n heads/successes/wins and m tails/failures/losses yields a $\text{Beta}(a+n, b+m)$ posterior. See Griffiths et al. 2008; Hoff 2009 for introductions to the Beta-Binomal model.) So, for example, if I had a maximally noncommittal $\text{Beta}(1,1)$ prior, after observing 150 heads in 300 tosses my beliefs about the bias π would be updated to a $\text{Beta}(151,151)$ distribution. This prior-to-posterior mapping is pictured in Fig. 1. The quite

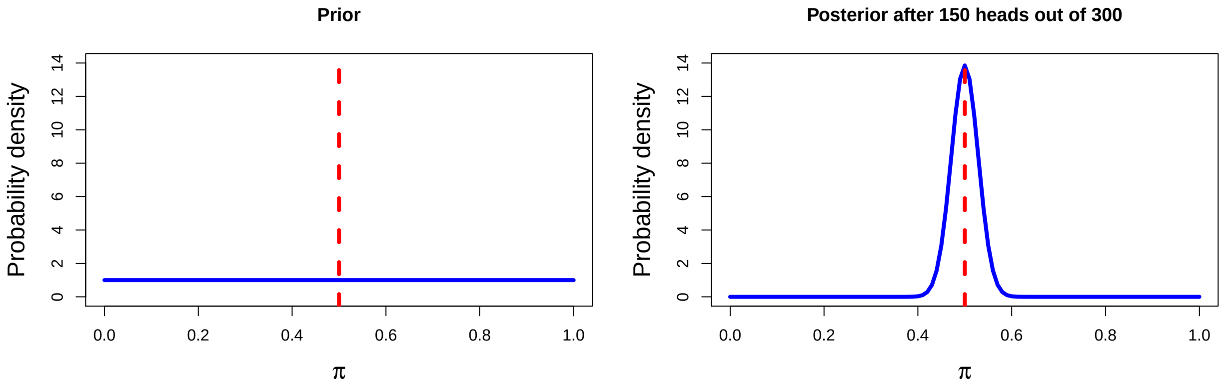


Figure 1: Prior-to-posterior mapping for an agent with precise credences and a Beta(1,1) prior, after observing 150 heads/successes out of 300 trials. The red line indicates the expected value of the parameter π, which does not change with this evidence even though our uncertainty about the estimate (i.e., the variance of π) decreases dramatically.

reasonable prediction is that, after observing 150/300 heads, you can be quite confident that the coin's bias π is close to 0.5—even if you were maximally noncommittal about π to begin with.

Not so in the imprecise credence model with the standard update rule of pointwise conditioning. I have no idea about the probability of heads initially, so my initial representor $\mathbb{P}_0$ contains, for every $r \in [0,1]$, a credence function P such that $P(\text{heads}) = r$. For example, $\mathbb{P}_0$ might contain, for every possible Beta prior, a measure that encodes a binomial model with that prior.

$$\mathbb{P}_0 = \{P \mid P(\pi) \sim \text{Beta}(a,b),\ \ \forall a,b \in [0,\infty)\}$$

(Using only Beta priors is a significant restriction relative to Joyce's philosophical desiderata, but using the full range of possible distributions would only make the problem worse.) Now, suppose I observe 150/300 heads and update $\mathbb{P}_0$ to $\mathbb{P}_1$ by pointwise conditionalization, discarding measures that assign probability 0 to the observations and so cannot generate the sequence. In this case, the latter condition requires us to discard any Beta prior with a 0 in either position, which could only generate "all heads" or "all tails" sequences. All other measures in $\mathbb{P}_0$ assign positive probability to the observed sequence of 150 heads and 150 tails, and survive in conditionalized form as $\text{Beta}(a+150, b+150)$ measures:

$$\begin{aligned}\mathbb{P}_1 &= \{P \mid P(\pi) \sim \text{Beta}(a+150, b+150),\ \ \forall a,b \in (0,\infty)\}\\ &= \{P \mid P(\pi) \sim \text{Beta}(a',b'),\ \ \forall a',b' \in (150,\infty)\}\end{aligned}$$

When we look at a few of these distributions, it is clear that something has gone wrong. Alongside reasonable-ish posteriors like $\text{Beta}(160,200)$ [so $P(\text{heads}) \approx .44$] and $\text{Beta}(200,160)$ [so $P(\text{heads}) \approx .56$], the posterior belief state contains a $\text{Beta}(150.1, 10^{14})$ posterior [where $P(\text{heads}) < 10^{-10}$] and a $\text{Beta}(10^{14}, 150.1)$ posterior, where $P(\text{heads})$ is indistinguishable from 1. This is truly remarkable, since the probability that we would have seen 150 or more heads in 300 if $P(\text{heads}) = 10^{-10}$ is around 10^{-87}—but this failure of prediction is not taken into account in update by pointwise conditioning. In fact, for every r in the open interval $(0,1)$, there is a measure in $\mathbb{P}_1$ such that $P(\text{heads}) = r$. As far as the spread of probabilities for heads is concerned, all that we have gained from our observations is to contract the interval $[0,1]$ to $(0,1)$, ensuring that both heads and tails are *possible* outcomes. We have learned *nothing else* about the coin's bias. But in reality, a sequence of 150 heads and 150 tails can and should teach us a lot, even if we know nothing at all about the coin to begin: it is almost certainly fair, or very close to it. Inductive learning *is* possible from a starting point of ignorance.

Several responses are possible here. First, we could search for an alternative to pointwise conditioning as an update rule. I won't speculate about how this would go. A second option would be to rule out representors where $P(\text{heads})$ may fall anywhere in $[0,1]$ or $(0,1)$. This would avoid the narrow problem addressed here, but it seems poorly motivated. If imprecise credences are motivated in the first place by considering belief under ignorance, how can we justify dealing with theoretical problems by *pretending* to know something that we don't? (Never mind that many such restricted models will still exhibit no learning, or will learn at an unbelievably slow rate.) A third option, floated by Joyce (2010), is to conclude that it is in fact *not* possible to learn in a rational way from a starting point of total ignorance. However, Joyce continues, real people employ non-rational heuristics to help them get by psychologically, such as restricting attention to measures that give high enough probability to the observed evidence. This response seems desperate, and if taken seriously it may imply that all of our beliefs are irrationally held: after all, for each of my beliefs there was some point at which I was totally ignorant on the subject.[1] A fourth option is to take this problem to demonstrate the impossibility of providing a precise formal model of belief states (Rinard, 2013). This could be correct, but I hope it isn't.

My preferred response is to reject imprecise credences as a model of individuals' belief states. To plump for this option, let me point out the key technical difference between precise- and imprecise-credence models that is creating this problem: whether we place a probability distribution on top of the set of credence functions in $\mathbb{P}_0$. Imprecise models decline to assign probabilities to the elements of $\mathbb{P}_0$, leaving it as an unstructured set. If we did put a distribution on $\mathbb{P}_0$, we would end up with a precise-credence model with a hierarchical structure, as I will describe in the next section. In this case, many kinds of (hyper-)priors on $\mathbb{P}_0$ would yield plausible results with ordinary conditioning. We can see why this small change makes a difference if we break down conditioning using Bayes' rule. With a distribution on the measures in $\mathbb{P}_0$, the posterior probability of each $P \in \mathbb{P}_0$ would be proportional to the product of the prior and the likelihood, where the latter is the probability that we would have observed the data if P were the true distribution. Conditioning re-ranks credence functions to take into account such facts—e.g., that 150/300 heads is moderately likely under a $\text{Beta}(160,200)$ distribution, and astronomically unlikely under a $\text{Beta}(150.1,10^{14})$ distribution. In contrast, imprecise models do not represent information about the relative plausibility of the measures in the representor, and pointwise conditioning does not take into account how well the measures in $\mathbb{P}_0$ fare in the goal of predicting the data (a likelihood term). This seems to be the basic reason why imprecise models fare so poorly when confronted with simple examples of inductive learning.

In order to extract a plausible treatment of learning from imprecise credence models we need

[1] We all began, in the womb, in a state of total ignorance, though we must presumably have been endowed with inductive biases. As psychologists and machine learning researchers are fond of reminding us, learning without initial biases (i.e., a hypothesis space and priors) is impossible: see, for example, Perfors 2012.

to put a distribution on $\mathbb{P}_0$ so that we can apply ordinary conditioning. In other words, we need a prior on our priors, which is the basic idea of hierarchical models.

4. Confidence and ignorance: A hierarchical model

This is, to be sure, a roundabout way of getting to a simple objection. We just don't *need* imprecise credences to represent the difference between confidence and ignorance in the sporting scenarios we started with. Arguments against precise models based on a supposed failure to represent this distinction are simply misdirected. Confidence and ignorance can be given a satisfying treatment within hierarchically structured models, which are well-developed formally and strongly motivated psychologically and computationally.

Recall Joyce's (2010, p.285) objection to precise models quoted above: in a situation of ignorance, it is not justifiable for you to have "extremely definite beliefs ... and very specific inductive policies", because "the evidence comes nowhere close to warranting such beliefs and policies". Already in the coin-bias example, though, this objection is at least partly misplaced.[2] If your prior on the bias parameter π is a $\text{Beta}(1,1)$ distribution (Fig. 1, left), your belief is anything but definite. It is true that π has a precise expected value 0.5, and also that your marginal belief about $P(\textbf{heads})$ is 0.5. However, you are extremely uncertain about both of these beliefs: depending on what evidence you receive, you could come to a very definite conclusion that π and $P(\textbf{heads})$ are both 0, both 1, or anywhere in between. For example, after observing 0/300 heads, your posterior distribution on π would be $\text{Beta}(1,301)$, with $P(\textbf{heads})$ indistinguishable from 0. *This* would be an "extremely definite" opinion, and one that is justified by the evidence. Similarly, after seeing 150/300 heads, you have a fairly definite opinion that π and $P(\textbf{heads})$ are close to 0.5 (Fig. 1, right). Even though the summary estimate $P(\textbf{heads}) = 0.5$ (red dashed line) does not change, the transition from the information state described by the left of Fig. 1 to the one on the right clearly represents a significant change in your beliefs about $P(\textbf{heads})$.

More generally, I suggest—building on observations made in another context by de Finetti 1977 and Pearl 1988 (p.357ff.)—that many of the intuitive arguments for imprecise probabilities discussed above can be accounted for in a better-motivated way once we take into account the hierarchical structure of belief. Our beliefs are interconnected, and probability estimates involving one variable usually depend on uncertain beliefs about others. Uncertainty about one variable—e.g., the bias π of a coin—may influence our uncertainty about a probability estimate of interest—e.g., the probability that the coin will come up heads on a given flip. Given the richness of our belief systems, there will usually be many layers of uncertainty. Even though such a model will always yield a precise numerical probability for any event of interest, this

[2] The part that may well hit home nonetheless is the accusation that precise credence models give rise to "very specific inductive policies" which are not warranted by the evidence. This is essentially the same point as the correct observation that precise credence models require priors that are not chosen on the basis of experience. Some authors have argued that priors should be chosen so as to maximize entropy (Jaynes, 2003; Williamson, 2009), though there are well-known objections to this move (van Fraassen, 1989). Does this mean that no choice of priors can be uniquely justified? Perhaps, but it is not clear why this should be so troubling. Since learning without priors is impossible, Bayesian cognitive models imply that evolution has supplied us with priors that are good enough to enable successful learning, starting in the womb. These may well vary between individuals, and there is no reason to expect that nature's choice of priors should be uniquely justified or rational. All we can expect is that they should get the job done with respect to the ultimate goals of survival and reproduction.

numerical value does not have any special place in the model: it is just what you get when you marginalize over the uncertainty of other relevant variables. In a hierarchical model, probability estimates can vary enormously in how "definite" they are—more precisely, in their variance.

Hierarchical models are used in many modern applications in psychology, philosophy, artificial intelligence, and statistics. In these models, probabilities are derived from graphs representing causal relations among variables, together with the conditional distribution on each variable given its parents. Uncertainty about one variable may influence the kind and degree of uncertainty in the value of another. For simplicity I will focus on Bayesian networks ("Bayes nets"), a simple propositional language for describing hierarchical models. (For discussion of richer languages for describing hierarchical Bayesian models that can treat uncertainty about individuals, properties, relations, etc., see for example Goodman et al. 2008; Goodman and Tenenbaum electronic; Tenenbaum et al. 2011 and, for a linguistically-oriented presentation, Goodman and Lassiter 2015.) I will impose a causal interpretation on the Bayes nets described in this paper. While this is not obligatory, it helps to gain intuitions about their meaning, and it is crucial to their psychological motivation (e.g., Glymour 2001; Sloman 2005).

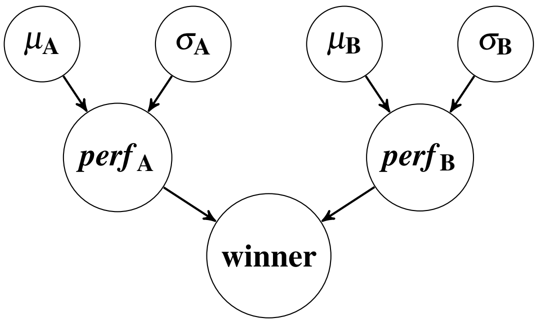
The sporting example that we began with allows us to illustrate Bayes nets and their ability to represent confidence and ignorance alike. Formally, a Bayes net B is an enrichment of familiar intensional semantics models, consisting of a set of possible worlds W together with:

1. A set of "variables" $V \in \mathbb{V}$, where each V is a partition of W. (A cell is a "value" of V.)
2. A set of "arrows", i.e., an acyclic binary relation on $\mathbb{V}$. (The inclusion of an arrow from V_i to V_j indicates that V_i is immediately causally relevant to V_j.)
3. A set of conditional probability tables which assign a distribution $P(V \mid Parents(V))$ to each $V \in \mathbb{V}$, where $Parents(V) = \{V' \mid \langle V', V\rangle \in \mathbb{V}\}$.

A probability measure P is *compatible* with Bayes net B if and only if P satisfies the *Markov condition*: each $V \in \mathbb{V}$ is probabilistically independent of its nondescendents, given its parents.

To situate the hierarchical modeling concept within our sporting examples, consider: In case (2), when asked to reason about the competition between unknown teams **A** and **B**, did you really know *nothing at all* about these teams? I doubt it. Most likely, you brought to bear on the problem a rich network of relevant background knowledge. You knew that the outcomes of matches are determined largely by the performance of the teams; that teams are composed of players who have different roles; that they have latent characteristics like skill and consistency; that not all teams are equally skilled or consistent; and so forth. In addition, your experience may have provided you with relevant population statistics which can help you to make an informed guess about the distribution of these characteristics among teams, even without any specific knowledge of the team. All of this background knowledge enabled you to make a reasonable guess about how a randomly chosen team would perform, and what factors you should attend to if you want to use observations to improve your forecast of a team's performance.

As a start in modeling the richer background knowledge that we implicitly bring to bear on such problems, consider the simplified representation in Fig. 2.[3] This model represents two key features of teams that are relevant to their performance: their **skill** and their **consistency**. Performance of team i is modeled as a Gaussian (normal) distribution with parameters μ_i (**skill**) and σ_i (**consistency**). As a result, the team's performance in any given competition is a noisy reflection of the team's true skill. Skill and consistency are, in turn, objects of uncertainty that we are trying to estimate when observing the outcomes of competitions. This means that we must place a prior on them as well. In a realistic model, these variables might be connected to many further factors—e.g., the team's composition, quality of coaching, motivation, etc. To simplify the example, I will summarize all of these sources of uncertainty with simple priors on the parameters: $\mu_{\mathbf{A}}$ and $\mu_{\mathbf{B}}$ are both distributed as $\mathcal{N}(0,1)$, and $\sigma_{\mathbf{A}} = \sigma_{\mathbf{B}} = .1$.



$$\forall i : \mu_i \sim \mathcal{N}(0,1)$$
$$\forall i : \sigma_i = .1$$
$$\forall i : perf_i \sim \mathcal{N}(\mu_i, \sigma_i)$$
$$\textbf{winner} = \mathbf{A} \text{ iff } perf_{\mathbf{A}} > perf_{\mathbf{B}}$$

Figure 2: Hierarchical model of a match between teams **A** and **B**.

In this model P(**A wins**) is equal to $P(perf_{\mathbf{A}} > perf_{\mathbf{B}})$—the probability that **A**'s noisy performance exceeds **B**'s. Note that this model does *not* generate a single, determinate prediction about **A**'s performance in any given match. Instead it generates for each team a distribution over an infinite set of performance values $(-\infty,\infty)$. A few of these distributions are shown in the top left of Fig. 3. As a result, the model encodes a distribution over an infinite set of values for P(**A wins**), which could be anywhere in $(0,1)$ depending on subsequent observations.

While the model does yield a precise best guess about the performance difference—and so about P(**A wins**)—this guess has no special status in the model: it is merely the result of marginalizing over our uncertainty about the parent variables (skill and consistency). Indeed, two models that generate the same probability estimate for this event—say, P(**A wins**) = .5—may vary considerably in how confident ("definite", "determinate") the probability estimate is.[4] A key factor is, of course, how much evidence the estimate is based on.

[3]The model is directly inspired by the Microsoft Trueskill system that is used to rank Xbox Live players in order to ensure engaging match-ups in online games: see Bishop 2013. It is also closely related to the tug-of-war model explored by Gerstenberg and Goodman (2012); Goodman and Lassiter (2015).

[4]As Pearl (1988, p.361-2) writes: "The point is to notice that by specifying a causal model for predicting the outcome ... we automatically specified the variance of that prediction. In other words, when humans encode probabilistic knowledge as a causal model of interacting variables, they automatically specify not only the marginal and joint distributions of the variables in the system, but also a particular procedure by which each marginal is to be computed, which in turn determines how these marginals may vary in the future. It is this implicit dynamic that makes probabilistic statements random events, admitting distributions, intervals, and other confidence measures." As a consequence, Joyce (2010, p. 283) is simply wrong in his assertion that "Proponents of precise models ... all agree that a rational believer must take a definite stand by having a sharp degree of belief" in situations of ignorance. While Joyce is right that taking a "definite stand" in case of ignorance is unreasonable, his conclusion

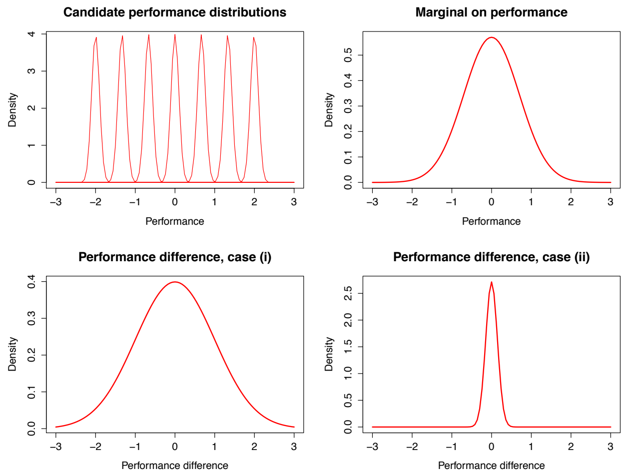


Figure 3: Some distributions implicit in the Fig. 2 model. Top left: some of the ∞ performance distributions that could turn out to be the true distribution for either team. Top right: Marginal on $\mathbf{perf}_{A/B}$ with no specific evidence. Bottom row: Distribution of $\mathbf{perf}_A - \mathbf{perf}_B$ with no observations (left) and after observing that each team won 15 of 30 matches (right).

Consider our two leading examples again. In case (1), we "know nothing"—i.e., only general domain knowledge is available. As a result, the variance of the estimated performance difference is high, and confidence in the estimate $P(\mathbf{A\ wins}) = .5$ is low (Fig. 3, bottom left). In case (2), there is ample evidence to indicate equal skill—many previous matches, with each team winning an equal number. In this case, the variance of the estimated performance difference is low, and confidence in the estimate $P(\mathbf{A\ wins}) = .5$ is high. The bottom right panel of Fig. 3 shows the model's predictions about $P(perf_{\mathbf{A}} > perf_{\mathbf{B}})$ once we have observed each team winning 15 of 30 matches. Here we can infer that the teams have roughly equal skill, and that we should forecast roughly equal performance in the next game: $P(\mathbf{A\ wins}) = .5$.

Bayes nets offer a precise credence model that represents the distinction between confidence and ignorance in a straightforward way. The need to represent this distinction does not, therefore, give us a reason to abandon precise credence models in favor of a more complex representation that also introduces new problems involving learning and decision. The apparent problem with precise models—that radically different credal states could generate the same probability estimate $P(\mathbf{A\ wins}) = .5$—was not due to any expressive limitation. Instead, the problem is generated by our habit as theorists of treating such numerical estimates as representations of belief states, forgetting that they give only a narrow window into the rich structure of a probability distribution and its potential to change in response to experience.

5. Dynamics of probabilistic language: An imprecise model

The third puzzle that we started with was how to understand the informational effect of explicitly probabilistic language. Example (3) is repeated here:

that precise credence models are inappropriate is a non sequitur: precise probability estimates can be extracted from hierarchical models, but these models do not generally imply a "definite stand" on these estimates.

(4) Two teams A and B who are about to compete, and you know nothing at all about them. However, a knowledgeable friend assures you that "Team A is likely to win." What probability should you assign to "A will win"?

This puzzle is a special case of the more general question of how we should update our beliefs on the basis of new information. However, in (3) the new information is provided in linguistic form, and so we have the dual problem of supplying an interpretation and an update procedure that will generate the right mapping from information states to modified information states.

In familiar models of linguistic dynamics, information states I are usually modeled as sets of worlds—or sometimes as sets of structured objects that segment out different kinds of information and handle them separately. Sentences S pick out, relative to a context c, properties of the kind of objects contained in I. So, if I is a set of worlds, $[\![S]\!]^c$ is a set of worlds as well. The algorithm for incorporating the information conveyed by S in c into state I is simple: we transition from state I to state $I \cap [\![S]\!]^c$, eliminating from I any worlds that are not in $[\![S]\!]^c$. On this approach to conversational dynamics, information states and sentence-meanings-in-context must be objects of the same type. This means that, if our language contains sentences whose meaning is not well treated as a set of worlds, an eliminative theory of update requires us to enrich the representation of information states accordingly.[5]

Now, recent work has given considerable semantic motivation to the claim that the interpretation of *A is likely to win* in (4) makes direct reference to a probability—roughly, "$P(\textbf{A wins}) > .5$" (Swanson, 2006; Yalcin, 2007, 2010; Lassiter, 2010, 2011, 2017a; Moss, 2015). This leaves us with a theoretical dilemma. If we want to hold to the eliminative conception of update, we can either try to give this probability statement a world-relative interpretation, or we can assign it some other interpretation and enrich our model of information states to compensate.

Yalcin 2012 proposes a simple eliminative model of update for both factual and probabilistic statements, building on Yalcin 2007. On this account epistemic statements—including probabilistic statements—do not have a world-relative interpretation. Instead, they depend on the value of a *sui generis* information state parameter which varies independently of the choice of evaluation world, and which determines a probability measure P. Briefly, the idea is that a conversational common ground C is a set of pairs $i = \langle s_i, P_i \rangle$, where s_i is a set of worlds and P_i is a probability measure with $P_i(s_i) = 1$. For factual statements such as *It's raining*, update eliminates from C those i for which it is not raining everywhere in s_i, without constraining P_i.

$$I \underset{\text{update}}{\Longrightarrow} I \cap \{\langle s, P \rangle \mid \forall w \in S : \text{It's raining at w}\}.$$

For probabilistic statements such as *It's likely to rain*, update eliminates points $i \in C$ that do not assign sufficiently high probability to rain, but places no direct constraints on s_i.

$$I \underset{\text{update}}{\Longrightarrow} I \cap \{\langle s, P \rangle \mid P(\textbf{rain}) > .5\}.$$

[5] An alternative is to modify the definition of update, giving pointwise definitions for individual expressions, as Veltman (1996) does for *might* and several other epistemic operators. However, this approach is not promising for *likely*, and I will not consider it further.

This formal model of conversational dynamics bears a striking resemblance to the sets-of-measures model of credence that we considered above. However, there are two very different ways to interpret it. Yalcin's proposal is to use it to model the dynamics of conversational common ground, in the mold of Stalnaker 1978. The idea is that, as a conversation proceeds, the acceptance of utterances leads to an accumulation of constraints on interlocutors' information. Once "It's likely to rain" is accepted, the common ground contains the information that $P(\mathbf{rain}) > .5$, meaning that interlocutors are publicly committed to this constraint. This interpretation is conceptually close to the "group belief" interpretation of imprecise probability models discussed above. As mentioned above, I have no quarrel with the group belief interpretation of imprecise credences, where measures in the set represent assignments of probability that are consistent with existing group commitments; the objections canvassed were specifically leveled at an application to individual psychology. For similar reasons, Yalcin's interpretation seems unproblematic as a way of treating the way that conversational commitments constrain the way that common ground constrains (but does not determine) probability assignments.

Solving the puzzle in (3)/(4) requires a more ambitious theory, though. It is not enough to require that someone who accepts *A is likely to win* must assign $P(\mathbf{A\ wins}) > .5$. This constraint does not tell us enough about what that person *should* come to believe about $P(\mathbf{A\ wins})$, other than the bare fact that $P(\mathbf{A\ wins})$ cannot fail to exceed .5. What we are interested in is a mapping from an *individual*'s prior state of information to a posterior state, which would determine what she should believe if she begins in state I and then gains some explicit information about the likelihood of events. While it was not proposed for this purpose, Yalcin's formal apparatus could equally be put to use in this way (cf. also Rothschild 2012). On this interpretation, an individual's state of information I is a set of pairs $i = \langle s_i, P_i \rangle$, and we have a simple algorithm for updating with the information conveyed by *A is likely to win*: as in Yalcin's proposal, map I to the subset of I containing all $\langle s_i, P_i \rangle$ for which $P_i(\mathbf{A\ wins}) \not> .5$.

While this proposal is *prima facie* plausible, it encounters some serious difficulties. First, as a representation of individual psychological states its plausibility is threatened by general objections to the use of imprecise credence models for this purpose: problems with framing a decision theory, with updating beliefs from a starting point of ignorance, and so forth. Second, even if we were to accept imprecise credence models along the lines of Joyce (2005, 2010), the update procedure just described would not be sufficiently general. The problem is that imprecise probabilities are intended to represent situations where probabilities are not known—but probabilistic statements can be informative about known and unknown probabilities alike.

Consider a scenario in which a ball is drawn from one of two urns. Urn A contains 10 red and 5 blue balls, so $P(\mathbf{red} \mid \mathbf{A}) = 2/3$. Urn B contains 5 red and 10 blue balls, so $P(\mathbf{red} \mid \mathbf{B}) = 1/3$. A fair coin was flipped to determine which urn the ball would come from—A if heads, B if tails. So, $P(\mathbf{A}) = P(\mathbf{B}) = 1/2$. If someone who knows what urn was selected tells us *The ball is probably red*, how should we respond? Clearly, we can conclude that the coin toss came up heads and A was selected. So the posterior probability of **red**, after update with *The ball is probably red*, should be equal to $P(\mathbf{red} \mid \mathbf{A}) = 2/3$.

However, it is not possible to model this kind of update by filtering in a standard imprecise probability model: paradoxically, we know too much. That is, we could attempt to represent this situation in terms of an imprecise model where some measures have $P(\mathbf{red}) = 2/3$ and some have $P(\mathbf{red}) = 1/3$. Then, upon learning that the ball is probably red, we could model the update effect of this information by eliminating the measures where $P(\mathbf{red}) = 1/3$. But as Joyce (2005, 2010) emphasizes, this model is inappropriate: it leaves out known probabilities, i.e., the information that the choice of urn was determined by the flip of a fair coin. Since $P(\mathbf{A}) = P(\mathbf{B}) = 1/2$, all measures P in our information state have

$$\begin{aligned} P(\mathbf{red}) &= P(\mathbf{red} \mid \mathbf{A}) \times P(\mathbf{A}) + P(\mathbf{red} \mid \mathbf{B}) \times P(\mathbf{B}) \\ &= 2/3 \times 1/2 + 1/3 \times 1/2 \\ &= .5 \end{aligned}$$

But if $P(\mathbf{red}) = .5$ according to all measures in our information state, the model of probabilistic update under consideration—"throw out all measures on which $P(\mathbf{red}) \nsucc .5$"—will yield the empty information state. If only we didn't know that the choice of urn was determined by a fair coin toss, we could update with the information that the ball is probably red! The filtering approach to update with probabilistic language does not, it appears, play nicely with the kinds of imprecise credence models that have been given independent motivation in the philosophical and statistical literature.

6. Dynamics of probabilistic language: A hierarchical model

Our problem is to explain why, in the urn model just given, update with *The ball is probably red* leads to a coherent result—and to one which somehow yields the judgment that $P(\mathbf{red})$ is precisely $2/3$. As in the general discussion of precise vs. imprecise credence models, I suggest that the solution to our problem is to pay closer attention to the hierarchical structure of information states. Consider a causal Bayes net representing this process (Fig. 4). The key thing to observe about this model is that the intuitive update effect of *The ball is probably red* is exactly the same as the intuitive update of *The coin came up heads*. Our goal is to find a way to use the structure of the Bayes net to guarantee that this will be the result, against this informational background. Once this is done, we may be able to define a general update procedure that applies to probabilistic and non-probabilistic language alike.

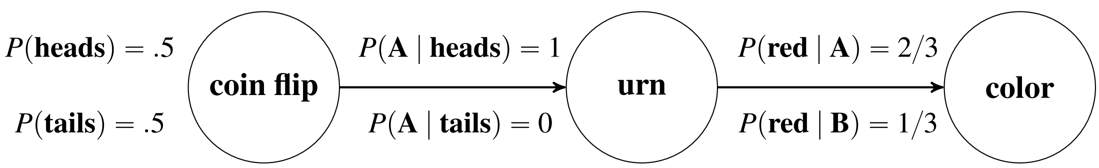


Figure 4: Causal Bayes net modeling the urn scenario.

A Bayes net defines a way of partitioning the space of possible worlds into increasingly fine-grained cells as a causal process unfolds. The first step in the process is the flip of a coin, which has two possible outcomes with specified probabilities. If we happen to be at a world w in which the coin came up heads, then an urn is selected. In this model, the urn is A with probability 1 in this case. So, w–and any other heads-world—is also an A-world. The red/blue mix of the urn selected in w is 10/5, and so the probability that the ball selected will be red is 2/3. The next step is the choice of a ball: at any w, either the ball chosen is actually red, or it is actually blue. Nevertheless, it is a fact about w that the probability of a red ball being selected is 2/3, even if the random selection process actually unfolds so that a blue ball is chosen. The Bayes net thus suggests a world-relative probability concept, where probabilities are dissociated from the actual occurrence of events. As long as our observations do not include the ball's color or any downstream effects of this variable, it is true at any such w that the ball is probably red, because this is a world at which the coin came up heads and the urn selected was A.

My suggestion, then, is to interpret probability statements as involving a kind of world-bound probability, but relativized to a Bayes net B. (At least probability statements with an "objective" flavor—see caveats below.) Suppose that the statement is *The ball is probably red*. Rather than looking for a global, world-independent parameter P and checking the value of $P(\mathbf{red})$ (as in Yalcin 2007, 2012), we look to $P_w(\mathbf{red})$, the probability that B assigns to **red** at world w. With a world-bound probability concept available, we could then model update with *The ball is probably red* as simple conditionalization, a procedure that works equally for factual statements. Here, update means conditioning on the set of worlds w' such that $P_{w'}(\mathbf{red}) > .5$.

(5) a. $[\![\text{The ball is probably red}]\!]^{B,w} = 1$ iff $P_w(\mathbf{red}) > .5$.
b. $P \underset{\text{update with (5a)}}{\Longrightarrow} P(\cdot \mid \{w' \mid P_{w'}(\mathbf{red}) > .5\})$.

If this is to work, the key question is how B and w conspire to determine P_w. Recall from above that the intuitive update resulting from *The ball is probably red* is the same as the update from *Urn A was selected*: both tell us, in effect, that $P(\mathbf{red}) = 2/3$. Relative to the Bayes net in Fig. 4, then, the set of worlds in which *The ball is probably red* is true should be the same as the set of worlds in which *Urn A is selected* is true. As a first approximation, we could define $P_w(\mathbf{red})$, relative to B, to be equal to the conditional probability of **red** in B given the actual value(s) at w of the immediate parent(s) of the variable of which **red** is a value. Since the only parent of **color** is **urn**, this means that $P_w(\mathbf{red}) = P(\mathbf{red} \mid \mathbf{urn}_w)$, where $\mathbf{urn}_w$ is the actual value of **urn** at w. If the urn is A in w, then $P_w(\mathbf{red}) = 2/3$. If the urn is B at w, then $P_w(\mathbf{red}) = 1/3$.

If we define P_w in terms of the structure of a Bayes net in this way, the contextual equivalence of *The ball is probably red* and *Urn A was selected* follows immediately. Relative to the Bayes net in Fig. 4, the set of worlds w where $P_w(\mathbf{red}) > .5$ is the same as the set of worlds where $P(\mathbf{red} \mid \mathbf{urn}) > .5$, relative to the actual value of **urn** at w. Relative to this model, the intension of *The ball is probably red*—$\{w \mid P_w(\mathbf{red} > .5\}$—is the same as the intension of *The Urn selected is A*. So, of course, conditioning on either has the same update effect.

We can now return to the puzzle around how to update with (3)/(4), *Team A is likely to win*. If we know nothing about these teams beyond general domain knowledge, our information might be represented by the Bayes net in Fig. 2 above. On the present proposal the intension of *Team A is likely to win*, relative to this Bayes net, is $\{w \mid P_w(\mathbf{winner} = A) > .5\}$. The parents of **winner** in this model are $perf_A$ and $perf_B$. So, by the definition of P_w offered above, this is the set of worlds w where the probability of A winning is greater than .5, given the actual values of $perf_A$ and $perf_B$ at w. This result is problematic, since it implies that $P_w(\mathbf{winner})$ should be 1 or 0 at every world. This is because the value of **winner** is a deterministic function of its parents—**winner** $= A$ if $perf_A > perf_B$, otherwise $= B$. My suggestion is that we should look not necessarily to a variable's immediate parents, but to its closest non-deterministic parents.

> Final proposal: $P_w(V = v)$ is equal to the conditional probability of A given the actual values at w of V's closest non-deterministic ancestors in B.

On this proposal, the truth-value of *Team A is likely to win* at any w, relative to this model, is determined by the values of μ_A, σ_A, μ_B, and σ_B at w. These variables represent the facts at w about the teams' skill and consistency, respectively. Given the assumptions that we made in setting up the Fig. 2 model, *Team A is likely to win* ends up having a sensible update effect: it is equivalent to $\mu_A > \mu_B$, i.e., the proposition that Team A is more skilled than Team B. Fig. 5 shows graphically the effect of updating an uninformed prior distribution with this information.

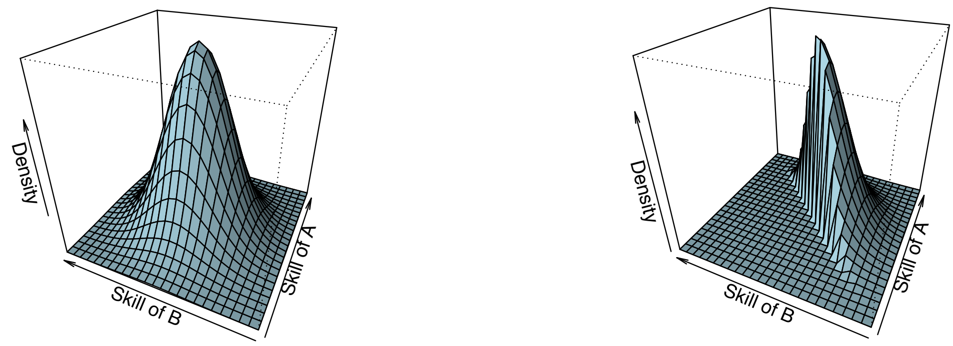


Figure 5: Left: 2-dimensional Gaussian representing an uninformed prior on the teams' skills. Right: posterior after learning that Team A is likely to win.

This proposal is tentative and subject to important caveats: I will mention only two for reasons of space. First, the final proposal might need to be circumscribed so that it applies only when neither V nor any of its descendants has been observed. After all, if we have observed that A won, then $P(\textbf{winner} = A)$ should be 1. However, note that this observation could not have been made in the scenario under consideration, since the key example was a prediction about a future event which could not in principle have been observed. In general, a complete theory along these lines will need to be more explicit about the role of time—about the way that causal processes unfold in time, about the way that probability estimates change over time in response to new observations, and any interactions between the two. While I do not feel that I have a complete grasp of the complex issues at stake here, it does seem worth noting that it is often unproblematic to assert an explicitly tensed statement of the form ϕ *was likely and* $\neg\phi$—e.g., *Team A was likely to win, but they didn't win*. This is striking, since present-tense statements of the form ϕ *is likely, but* $\neg\phi$ are generally infelicitous (Yalcin, 2007). The difference in the past-tense case seems to be that there are two different times involved: an earlier time at which the "worldly" probability of A winning was greater than .5, e.g., because A is a more skilled team; and a later time at which the speaker learned that A didn't win, despite their advantageous position. So, we should not redefine P_w such that $P_w(V = v)$ is always 0 or 1 whenever the value of variable V has been observed. Instead, we need to explicitly incorporate an element of time: $P_{(w,t)}(V = v)$ is 0 or 1 if V has been observed at or before t. However, I will not attempt it in this space to working out the temporal aspect in detail or its connections to Yalcin's observations about "epistemic contradictions".

A second caveat is that my proposal may apply only to certain kinds of probability statements. Theoretical and corpus studies have found evidence that what we have called "probabilistic" language is ambiguous between multiple kinds of probability that are ontologically and psychologically distinct (Kahneman and Tversky, 1982). The probability statements that I have analyzed in the second part of this paper seem to relate to a kind of "objective", "worldly", or "stochastic" probability, relating to the unfolding of an indeterministic causal process. In contrast, most theorists in the semantic literature on probability expressions have explicitly or implicitly assumed that the subject matter of probabilistic language is *subjective* uncertainty. These positions are not in competition: Ülkümen et al. (2016), in particular, have shown that English has the semantic resources to talk about both kinds of uncertainty. They show that the two kinds of uncertainty are even distinguished lexically to some extent, with items such as *likely* and *chance* favoring stochastic interpretations while *confident*, *certain*, etc. favor subjective interpretations. Lassiter (2017b) gives further corpus evidence for this conclusion, and argues for several more semantically distinct interpretations of probability expressions.

The proposal floated here is most clearly suited to language describing stochastic causal processes, including (but not limited to) many future-oriented uses of probability expressions. I am exploring ways to extend it to clearly subjective uses like that in the corpus example in (6) (Lassiter, 2017b), where there is a clear fact of the matter and information is simply lacking.

(6) [T]he residential-scale reservoirs ... were likely used around 900 B.C. It's likely that the systems were lined with a thick, clay "plaster" ...

I am unsure whether this effort will be successful. I believe that it would be also be consistent with the proposal given here to model the update effect of such examples from a different perspective, such as Madsen's (2015) framework of "multi-agent statistics".

7. Conclusion

Imprecise credence models, which represent uncertainty using sets of probability measures, have a good deal of philosophical and linguistic motivation. However, their scope is more limited than has generally been recognized. Where the formal representation of uncertainty is concerned, imprecise credences may well be useful as a treatment of group belief. However, they encounter severe problems as a representation of individual-level uncertainty, particularly involving learning from a starting point of ignorance. I argued that these problems can be resolved by adopting an explicitly hierarchical perspective on belief states, and that hierarchical models already account for the confidence/ignorance distinction that has been used to motivate imprecise models as a representation of individual-level uncertainty. While I formalized this perspective using causal Bayes nets, there are also other, richer hierarchical models based on probabilistic programming techniques, which will probably be needed in a fuller treatment.

A second puzzle involving the update effects of expressions like ϕ *is likely* and *probably* ϕ

seemed initially to point to a formally parallel model, where information states are sets of measures (or something strictly richer). This model may well be sufficient as a common-ground model. However, it fails as a solution to the psychological problem of how agents can/should incorporate such statements into their information states, because it predicts that they should have trivial update effects when probabilities are known. I argued that we may be able to resolve this issue as well by attending to the hierarchical structure of belief states, interpreting at least some probabilistic statements as factual claims about stochastic causal processes rather than expressions of subjective uncertainty. While there is much more to be done to shore up this suggestion, I hope at least to have demonstrated that direct engagement between semantics and pragmatics, formal epistemology, computational cognitive science, and Bayesian statistics has significant potential to generate new concepts and useful theoretical models.

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Quantified indicative conditionals and the relative reading of *most*[1]

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Abstract. Kratzer (in press) notes a curious 'reverse' reading for certain quantified conditionals with *most*. The existence of this reading is problematic for accounts that aim at compositionally deriving the perceived interpretation of quantified conditionals, especially for those that take *if*-clauses to semantically restrict the domain of nominal quantifiers. We show how the reverse reading can be derived on such a restrictor account, as an instance of the relative reading of *most*. The derivation closely parallels a recent account of the 'reverse proportional' reading of *many* (Romero, 2015). Our account is entirely compositional and draws on independently motivated assumptions about the interpretation of *most*.

Keywords: conditionals, quantifiers, *most*, superlatives

1. Introduction: an old 'embarrassment'

Conditionals that appear to be embedded under other operators present a difficult testing ground for semantic theories of the natural language conditional. In this paper, we are concerned with quantified indicative conditionals (QICs), which combine an *if*-clause and a nominal quantifier:

(1) a. Every student passed if she studied hard.
    b. No student failed if she studied hard.

Although (1a) and (1b) are intuitively paraphrases (assuming that failing is not passing), analyses of QICs which simply embed an *if*-conditional under the quantifier have struggled to produce equivalent interpretations for these statements: "The embarrassment had been known for a long time, but nobody dared talk about it. Then Higginbotham (1986) dragged it into the open" (Kratzer, in press), by demonstrating the insufficiency of the classical material conditional analysis of *if* for interpreting the sentences in (1). While $\supset$ arguably produces acceptable truth conditions for (1a), the interpretation that results for (1b) is not equivalent — and, moreover, is patently inappropriate: (1b) does not entail that all students studied hard.

(2) a. (1a) $\equiv \forall[\textsc{student}][\textsc{study-hard} \supset \textsc{pass}]$
    All students are such that studying hard ensured passing.
    b. (1b) $\equiv \neg\exists[\textsc{student}][\textsc{study-hard} \supset \neg\textsc{pass}]$
    $\equiv \forall[\textsc{student}][\textsc{study-hard} \,\&\, \textsc{pass}]$
    All students are such that they both studied hard and passed.

This unfortunate result arises from the (now unpopular) identification of the material conditional $\supset$ with *if*. However, simply embedding the influential 'restrictor' conditional of Kratzer

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(1986) does not fare much better. Kratzer treats *if*-clauses as restricting the domain of a (covert) universal modal quantifier; (3) shows the results of embedding this under nominal quantifiers.

(3) a. (1a) $\equiv \forall[\textsc{student}][\Box[\textsc{study-hard}][\textsc{pass}(x)]]$
All students are such that studying hard must have resulted in success.
b. (1b) $\equiv \neg\exists[\textsc{student}][\Box[\textsc{study-hard}][\neg\textsc{pass}]]$
$\equiv \forall[\textsc{student}][\Diamond[\textsc{study-hard}][\textsc{pass}]]$
All students are such that it is possible that studying hard resulted in success.

1.1. The 'folkloric' solution: *if*-clauses restrict nominal quantifiers

One route around this problem questions whether QICs truly comprise embedded structures *à la* (2)-(3). A suggestion in the spirit of the Lewis-Kratzer conditional comes from von Fintel (1998). He suggests interpreting the *if*-clauses as restricting the nominal quantifiers directly. This yields the truth conditions in (4), which are both intuitively sensible and equivalent.

(4) a. (1a) $\equiv \forall[\textsc{student}\ \&\ \textsc{study-hard}][\textsc{pass}]$
All students who studied hard passed
b. (1b) $\equiv \neg\exists[\textsc{student}\ \&\ \textsc{study-hard}][\neg\textsc{pass}]$
No student who studied hard did not pass.

This 'folkloric' solution (named by von Fintel and Iatridou, 2002) is challenged by von Fintel and Iatridou (2002), Higginbotham (2003), and Huitink (2009). The main thrust of their objections involves comparisons between QICs and corresponding sentences where the *if*-clause is replaced by a relative clause attached directly to the overt restriction of the quantifier:

(5) a. Every coin is silver if it is in my pocket.
b. Every coin that is in my pocket is silver.

On the account in (4), these two sentences have identical truth conditions: treating the *if*-clause as restricting the quantifier domain should reduce it, functionally, to a restrictive relative clause. However, the sentences are not intuitively equivalent: (5a) suggests a non-accidental or rule-based connection between the location of a coin and its composition, which (5b) does not.

Leslie (2009) defends the restrictor analysis against this objection. She points out that the problematic QICs seem rule-oriented precisely because they appear to involve a generalization over multiple instances. That is, in the same way that (6a), on the standard restrictor account, has truth-conditions which require the specified coin to come up heads across all situations in which it is flipped, (6b) requires the same to hold of all the coins in the relevant domain.

(6) a. This coin comes up heads if it is flipped.
In all accessible worlds in which this coin is flipped, it comes up heads.
b. Every coin comes up heads if it is flipped.
In all accessible worlds, all of these coins that are flipped come up heads.

Leslie points out that a fair coin intuitively falsifies (6b), even if it happens to come up heads in a particular trial or set of trials. Thus, the truth conditions of (6) require quantification over situations, and suggest *modalizing* the restrictor account. On Leslie's proposal, *if*-clauses restrict nominal quantifiers, but, in cases like (6), this occurs below a wide-scope modal. This gives the truth conditions in (7) for our original QIC examples:

(7) a. (1a) $\equiv \Box\forall[\text{STUDENT} \,\&\, \text{STUDY-HARD}][\text{PASS}]$
All accessible worlds are such that all students who studied hard passed.
b. (1b) $\equiv \Box\neg\exists[\text{STUDENT} \,\&\, \text{STUDY-HARD}][\neg\text{PASS}]$
All accessible worlds are such that no students who studied hard did not pass.

As with von Fintel's (1998) solution, Leslie's *modalized restrictor conditional* provides sensible and equivalent truth conditions for these QICs. Her proposal arguably solves the problem of the contrast between QICs and restrictive relative clauses in cases like (5): the first case necessarily involves a modal quantifier, whereas the second does not.

(8) a. (5a) $\equiv \Box\forall[\text{COIN} \,\&\, \text{IN-MY-POCKET}][\text{SILVER}]$
In all accessible worlds, all coins in my pocket are silver.
b. (5b) $\equiv \forall[\text{COIN} \,\&\, \text{IN-MY-POCKET}][\text{SILVER}]$
In the actual world, all coins in my pocket are silver.

The 'non-accidental' connection in (5a) on this account emerges from quantification over accessible worlds. On the other hand, (5b) simply describes an actual-world situation.

1.2. The road ahead

Against this backdrop, Kratzer (in press) observes a new and surprising reading for certain QICs. In her examples, the conditional consequent appears to enter into the restriction of a nominal quantifier, and the conditional antecedent provides its scope (see Section 2). This seems to provide direct evidence against any kind of restrictor analysis.

This paper defends the restrictor conditional against this challenge. We argue that the key to 'reversed' readings of QICs comes from reverse proportional readings of quantified statements with *many* and *few* (Westerståhl, 1985). Building on Romero (2015), we propose that 'reverse' readings of *most*-QICs are instances of the relative reading of *most*, analyzed as the composition (Hackl, 2009; Romero, 2016) of parametrized MANY and the superlative, focus-sensitive morpheme *-est* (Heim, 1999). When composed with a restrictor analysis of conditionals, this predicts reverse readings for *most*-QICs in precisely the circumstances that Kratzer describes. We argue that our account improves on Kratzer's (in press) in terms of predictive power: reverse readings are predicted only for determiners (e.g., *most, many, few*) which contain the right focus-sensitive components, but not for other determiners (*every, all*, or *no*).

2. The reverse reading of *most*-QICs

Kratzer's empirical challenge centers on a previously unobserved reading for certain QICs:

(9) Most kids asked for calculators if they had to do long divisions. [Kratzer: pp.20-21]
  a. *Vanilla reading:* (standard)
  The majority of kids who had to do long divisions asked for calculators.
  $|\text{long-division kids} \cap \text{calculator kids}| > |\text{long-division kids} - \text{calculator kids}|$
  b. *Reverse reading:* (novel)
  The majority of kids who asked for calculators had to do long divisions.
  $|\text{calculator kids} \cap \text{long-division kids}| > |\text{calculator kids} - \text{long-division kids}|$

Given the standard interpretation (10) for *most*, the vanilla reading of (9) is easily generated. The contents of the *if*-clause appear to enter into the restriction ($A = \textsc{kid} \cap \textsc{do-long-div}$) of *most*, while the matrix clause provides its nuclear scope ($B = \textsc{use-calculator}$). This produces an interpretation equivalent to (9a).

(10) $Most[A][B] := |A \cap B| > |A - B|$

The reverse reading, on the other hand, is not so neat. Given (10), the matrix clause appears to enter the quantifier's restriction, while the *if*-clause provides its nuclear scope. This is a startling result, and it presents a serious problem for any restrictor analysis of *if*-clauses.

We concur with Kratzer that this new reading exists, and that it only emerges under very particular contextual conditions. (11) gives an appropriate context for reversal. Crucially, the matrix clause is backgrounded, while the *if*-clause provides new, or *focused* information.

(11) **You:** Did you see kids using calculators when you volunteered in your son's school yesterday? What did they use the calculators for?
Me: *Most kids asked for calculators if they had to do long divisions.* But I am pleased to report that most kids in my son's school do long divisions by hand.

The felicity of the sentence which follows (9) in the dialogue in (11) clearly demonstrates the reality of the reverse reading in this scenario. On the vanilla reading (9a), the final sentence directly contradicts the content of the QIC. On the other hand, if (9) is taken to mean (9b), it is perfectly coherent to continue with the information that the number of children doing long division by hand is greater than the number doing long division by other means.

Reverse readings do not seem to exist without the topic-focus structure illustrated in (11). In support of this point, consider (12), which backgrounds long division instead of calculator use.

(12) **You:** Did you see kids doing long division when you volunteered in your son's school yesterday? Were they able to do it by hand?
Me: *Most kids asked for calculators if they had to do long divisions.* #But I am pleased to report that most kids in my son's school do long divisions by hand.

Ultimately, the existence of reverse QIC readings in any context presents a serious challenge to restrictor analyses, whether folkloric, modalized, or otherwise. If the contents of an *if*-clause are entered into the restriction of a quantifier, it is not at all clear how they are available to provide its nuclear scope as well. Given the tools to hand, including the quantifier meaning (10) for *most*, it seems that we must give up on the concept of *if* as an operator on quantifier domains if we wish to be able to account for the empirical QIC terrain.

3. Kratzer's analysis

3.1. A bomb defused

Based on the arguments mentioned in the introduction, Kratzer's approach to the QIC problem begins from the premise that *if*-clauses do not restrict nominal quantifiers. Instead, she postulates a embedded structure in which a binary conditional operator ($\triangleright$) and its sentential arguments are fully contained in the nuclear scope of the quantifier, as shown in (13).

(13) a. (1a) $\equiv \forall[\text{STUDENT}][\text{STUDY-HARD} \triangleright \text{PASS}]$
b. (1b) $\equiv \neg\exists[\text{STUDENT}][\text{STUDY-HARD} \triangleright \neg\text{PASS}]$

Given this structure, Kratzer argues that $\triangleright$ must support the following set of logical inferences:

(14) a. **Modus ponens.** $\phi \triangleright \psi$ and ϕ jointly entail ψ
b. **Contraposition.** $\phi \triangleright \psi$ entails $\neg\psi \triangleright \phi$
c. **Conditional excluded middle.** For all ϕ, ψ: either $\phi \triangleright \psi$ or $\phi \triangleright \neg\psi$
d. **Weak Boethius' thesis.** $\phi \triangleright \neg\psi$ entails $\neg(\phi \triangleright \psi)$

The first two patterns are relatively standard assumptions in the literature on conditionals, although they are not without challenge (see McGee, 1985). (14c) follows from the structural assumption in (13), and the desired equivalence between (1a) and (1b):

(15)
$$\begin{array}{lll} & \forall x[\phi \triangleright \psi] \equiv \neg\exists x[\phi \triangleright \neg\psi] & \text{(desired equivalence, cf (1))} \\ \Longrightarrow & \forall x[\phi \triangleright \psi] \equiv \forall x \neg[\phi \triangleright \neg\psi] & \text{(DeMorgan's law)} \\ \Longrightarrow & \phi \triangleright \psi \equiv \neg[\phi \triangleright \neg\psi] & \\ \Longrightarrow & \neg[\phi \triangleright \psi] \equiv \phi \triangleright \neg\psi & \end{array}$$

(14d) follows from (14c), on the assumption that at most one of $\phi \triangleright \psi$ or its negation ($\phi \triangleright \neg\psi$) can be true. Given a bivalent logic, these inferences lead to a 'bombshell' for the semantics of conditionals (Pizzi and Williamson, 2005). Any connective $\triangleright$ which satisfies all of the properties in (14) must be equivalent to the material biconditional: $\phi \triangleright \psi \equiv \phi \supset \psi \wedge \psi \supset \phi$!

This result leaves Kratzer in a difficult position, since it is not plausible that natural language *if … then* semantically expresses the material biconditional outside of QICs. The only apparent workaround is to suggest, as Kratzer does, that "some element in the syntactic environment of the embedded conditionals … obscures their compositional meaning contribution." The particular element she appeals to is pragmatic domain restriction (von Fintel, 1994; Stanley and

Szabó, 2000), associated with the determiner. The argument proceeds as follows.

Kratzer proposes that (past-tense) QICs embed a material conditional. This leaves us with Higginbotham's original problem: (1a) and (1b) are no longer equivalent, and the truth conditions for (1b) (reproduced below) do not reflect its intuitive meaning.

(16) No student failed if she studied hard.
$\neg\exists[\text{STUDENT}][\text{STUDY-HARD} \supset \neg\text{PASS}]$
All students both studied hard and passed.

Now, however, the quantificational determiner comes along with a domain variable. This variable is valued pragmatically, and its value ends up in the quantifier restriction.

(17) No$_D$ student failed if she studied hard.
$\neg\exists[\text{STUDENT}\,\&\,D][\text{STUDY-HARD} \supset \neg\text{PASS}]$

Kratzer suggests that a natural default for the value of D is the *if*-clause. Since this is also part of the material conditional, this means that *if*-clauses in 'neutral' QICs perform double duty: as pragmatic restrictors of nominal quantifiers and as antecedents of embedded conditionals.

(18) No$_D$ student failed if she studied hard.
$\neg\exists[\text{STUDENT}\,\&\,\text{STUDY-HARD}(=D)][\text{STUDY-HARD} \supset \neg\text{PASS}]$

If the conditional antecedent is pragmatically assigned to the domain variable, as in (18), its role in the conditional becomes redundant, and we wind up with the interpretation in (19c). von Fintel (1998)'s folkloric solution, (4), in which the *if*-clause was taken to semantically restrict the quantifier domain. As a result of this, the combination of an embedded conditional with pragmatic domain restriction does indeed produce interpretive equivalence between (1a) and (1b).

(19) Every$_D$ student passed if she studied hard.
a. **Semantic meaning:** $\forall[\text{STUDENT}][\text{STUDY-HARD} \supset \text{PASS}]$
b. **After pragmatic restriction:**
$\forall[\text{STUDENT}\,\&\,\text{STUDY-HARD}][\text{STUDY-HARD} \supset \text{PASS}]$
c. **Equivalent to:** $\forall[\text{STUDENT}\,\&\,\text{STUDY-HARD}][\text{PASS}]$

(20) No$_D$ student failed if she studied hard.
a. **Semantic meaning:** $\neg\exists[\text{STUDENT}][\text{STUDY-HARD} \supset \neg\text{PASS}]$
b. **After pragmatic restriction:**
$\neg\exists[\text{STUDENT}\,\&\,\text{STUDY-HARD}][\text{STUDY-HARD} \supset \neg\text{PASS}]$
c. **Equivalent to:** $\neg\exists[\text{STUDENT}\,\&\,\text{STUDY-HARD}][\neg\text{PASS}]$

The semantic meanings in (19a) and (20a) do not reflect the perceived equivalence of (1a) and (1b). This means that the conditional operator $\supset$ need not satisfy *conditional excluded middle* (14c) and *weak Boethius' thesis* (14d), and Pizzi and Williamson's bombshell does not apply.

3.2. Reversal

Reverse readings enter the picture at this point, as evidence of the process of pragmatic domain restriction. In the unmarked case, domain restriction proceeds as above: the antecedent enters into the restriction of the quantifier, and we obtain the vanilla reading for a conditional like (9).

(21) Most$_D$ kids asked for calculators if they had to do long divisions.
   a. **Semantic meaning:** *Most*[KID][LONG-DIV ⊃ CALC]
   b. **After pragmatic restriction:** *Most*[KID & LONG-DIV][LONG-DIV ⊃ CALC]
   c. **Equivalent to:** *Most*[KID & LONG-DIV][CALC]
   d. **Paraphrase:** *Most kids who had to do long divisions used calculators.*

However, since domain restriction occurs pragmatically, it should be possible for something other than the conditional antecedent to value the domain variable *D*. Kratzer suggests that this happens in marked (non-neutral) cases, like the context in (11). Specifically, a reverse reading is predicted if the domain variable picks up the conditional consequent as its value: this situation plausibly occurs when the consequent is backgrounded and the antecedent is focused.

(22) Most$_D$ kids asked for calculators if they had to do [long divisions]$_\mathbf{F}$.
   a. **Semantic meaning:** *Most*[KID][LONG-DIV ⊃ CALC]
   b. **After pragmatic restriction:** *Most*[KID & CALC][LONG-DIV ⊃ CALC]
   c. **Paraphrase:** *Most kids who used calculators either did not have to do long divisions or used calculators (to do them).*

If *D* is the conditional consequent, the embedded material conditional is not reducible, and we get the interpretation in (22). This is not quite the meaning we are after: note that (22) is satisfied if most of the students who used calculators simply did not have to do long-divisions. To get us to the correct interpretation, on which most of the calculator users did in fact have to do long divisions, Kratzer posits that the conditional operator in this case must be interpreted biconditionally, via an embedded application of *conditional perfection* (Geis and Zwicky, 1971).

(23) Most$_D$ kids asked for calculators if they had to do long divisions]$_\mathbf{F}$.
   a. **Semantic meaning:** *Most*[KID][LONG-DIV ⊃ CALC]
   b. **After pragmatic restriction:** *Most*[KID & CALC][LONG-DIV ⊃ CALC]
   c. **After embedded perfection:** *Most*[KID & CALC][LONG-DIV ≡ CALC]
   d. **Equivalent to:** *Most*[KID & CALC][LONG-DIV]
   e. **Paraphrase:** *Most kids who used calculators had to do long divisions.*

If perfection turns the embedded conditional into a biconditional, we wind up in a similar position as in (19) and (20). In this case, since it is the consequent that enters the restriction of the quantifier, it is the consequent that is redundant. This results in the interpretation indicated in (23d) and (23e), which effectively reverses the roles of conditional antecedent and consequent as compared to the neutral case in (21).

3.3. The consequences

Kratzer's approach represents a rather radical move. The account she presents is ultimately non-compositional: even the accessible vanilla interpretation of QICs like (1a)-(1b) does not result from the simple composition of a conditional with a wide-scope nominal quantifier, but also requires the input of a pragmatic operation which – crucially – can have a different outcome. In addition, the appeal to conditional perfection for the reverse reading is not wholly innocent. For one, it must be applied in an embedded position, which throws into question its widely-accepted status as a pragmatic inference. Moreover, conditional perfection in many cases strengthens a conditional to something weaker than a full biconditional: for instance, *if p, then q* may suggest that *q* is not unconditional, rather than the full converse, *if not p, then not q* (von Fintel, 2001; Franke, 2009). If conditional perfection is to unerringly produce the result required for the derivation in (23), it seems that we will require a new, more direct, mechanism.

Finally, there is a rather more immediate problem with Kratzer's account: it makes incorrect predictions. Concretely, the crucial feature in producing a reverse interpretation for a conditional is the presence of focus within the antecedent; properties of the wide-scope quantifier do not play a role. As a result, reverse readings should exist, given the right context, for QICs with any quantifier, not just with *most*. This is not the case: these readings are unattested with the universal quantifier (24), and do not arise even when the appropriate context is provided (25).[2]

(24) Every kid asked for a calculator if she had to do long divisions.
  a. **Predicted vanilla reading (attested):**
  All kids who had to do long divisions asked for calculators.
  b. **Predicted reverse reading (unattested):**
  All kids who asked for calculators were ones who had to do long divisions.

(25) **You:** Did you see kids using calculators when you volunteered in your son's school yesterday? What did they use the calculators for?
Me: *Every kid asked for a calculator if she had to do long divisions.* #But I am pleased to report that some kids in my son's school do long divisions by hand.

As in (11), a reverse reading of the conditional in (25) would be compatible with the given continuation, but the vanilla reading produces a contradiction. We find only the latter case, against the prediction made by Kratzer's account.

We suggest that it is not an accident that the first attestation of a reverse reading uses the quantifier *most*. Rather, it is because the choice of quantifier plays a role in the availability (and derivation) of these interpretations. Together with the theoretical issues noted above, Kratzer's problematic predictions make holding out for a different analysis of QICs an attractive option. A suitable analysis, we propose, should (i) derive the equivalence of (1a) and (1b) as the outcome of semantic composition. It should also (ii) account for the existence of reverse readings in the contexts described by Kratzer – but it should, crucially, only do this for the quantifiers which actually exhibit these readings.

[2]The two readings are equivalent under *no*, due to the symmetric property of this determiner.

We have already seen that a restrictor analysis can deliver on (i). In the remainder of this paper, we show that it can also deliver on (ii): when the properties that differentiate quantifiers like *most* from those like *every* (and *no*) are taken into account, a restrictor analysis is not only able to produce reverse readings but also improves on Kratzer's predictions in this regard. Crucial inspiration for our account comes from recent work on reverse proportional readings of *many*.

4. The reverse-proportional reading of *many*

Descriptively, we can distinguish at least three meanings for sentences of the form *Many Ps are Qs*. The first two are the *cardinal* reading in (27) and the *proportional* reading in (28).

(26) Many Scandinavians have won the Nobel Prize in literature.

(27) **Cardinal:** $Many_{\text{card}}[P][Q] \equiv |P \cap Q| > n$, where n is 'large' number.
The number of Scandinavians NP-lit winners is large.

(28) **Proportional:** $Many_{\text{prop}}[P][Q] \equiv \frac{|P\cap Q|}{|P|} > k$, where k is a 'large' proportion.
The ratio of Scandinavian NP-lit winners to all Scandinavians is high.

Westerståhl (1985) points out that, with 14 Scandinavian Nobel winners (as of 1984) and millions of Scandinavians, both these readings likely come out false. And yet, (26) appears to have a reading on which it is true, and this is intuitively so because 14 Scandinavians out of 81 Nobel Prize winners "seems rather (too?) many" (p. 403). But neither (27) nor (28) compares the number of Scandinavian winners ($|P \cap Q| = 14$) to the number of all winners ($|Q| = 81$). We can characterize this 'reverse proportional' reading as in (29).

(29) **Reverse proportional:** $Many_{\text{r-prop}}[P][Q] \equiv \frac{|P\cap Q|}{|Q|} > k$, where k is a 'large' proportion.
The ratio of Scandinavian NP-lit winners to all NP-lit winners is high.

Note that the reverse proportional reading is just the proportional reading with the arguments reversed, *i.e.*, $Many_{\text{r-prop}}[P][Q] \equiv Many_{\text{prop}}[Q][P]$. Just as antecedent and consequent seem to 'switch places' in the reverse readings of *most*-QICs, the nominal complement and the VP seem to 'switch places' in the reverse proportional reading of *many*.

Stipulating (29) as a separate lexical meaning of *many* is undesirable not only on general grounds (Grice's 'modified Occam's razor'), but also because, if (29) were the meaning of a lexicalized determiner, it would violate the *conservativity universal* (Barwise and Cooper, 1981; Keenan and Stavi, 1986). Consequently, several authors have sought to reduce (29) to one of the the other recognized readings. Here, we draw on Romero (2015)'s analysis of the reverse proportional reading, as it is the one most readily adapted to our purposes. Romero extends Hackl's (2000, 2009) account of *more* and *most* as the combination of an underlying operator MANY with the comparative *-er* and the superlative *-est*, respectively. Likewise, Romero takes English *many* to decompose into MANY plus the (silent) positive morpheme POS that is also present in the positive form of adjectives (von Stechow, 1984).

Romero also draws on arguments by Schwarz (2010) showing that POS displays a relative/absolute ambiguity, and combines this with Herburger's (1997) observation that the reverse proportional reading is facilitated by stress on the first argument of the determiner. Consequently, she provides a lexical entry for POS that is dependent on a set of alternatives generated by an alternative semantics (Rooth, 1992), much as in Heim (1999)'s analysis of the superlative.

Romero takes the underlying operator MANY to be ambiguous between a cardinal and a proportional reading. Both are 'parameterized determiners' in the sense of Hackl (2000), i.e., they have generalized determiner meanings with an extra (degree) argument. $\text{MANY}_{\text{card}}$ simply counts the individuals that jointly satisfy both its non-degree arguments, while $\text{MANY}_{\text{prop}}$ computes their proportion. Both of these meanings are conservative for any fixed degree d.

(30) a. $\text{MANY}_{\text{card}} := \lambda d_n \lambda P_{et} \lambda Q_{et}. |P \cap Q| \geq d$, where n is the degree-type.
b. $\text{MANY}_{\text{prop}} := \lambda d_n \lambda P_{et} \lambda Q_{et}.(|P \cap Q| : |P|) \geq d$

In order to yield a truth-evaluable statement, both these operators must combine with a degree operator like POS (for surface *many*), comparative *-er* (*more*) or superlative *-est* (*most*). POS combines with a property P of degrees and claims that there is a degree d of which P is true and which exceeds the standard of comparison θ. Crucially, this standard of comparison is calculated on the basis of a comparison class $\mathbf{C}$ (a set of degree properties):[3]

(31) $\text{POS} = \lambda \mathbf{C}_{nt,t} \lambda P_{nt}.\exists d[P(d) \wedge d > \theta(\mathbf{C})]$
where θ is a function that maps comparison classes to degrees.[4]

As in Heim (1999)'s analysis of the superlative, the degree morpheme scopes independently and uses focus structure to constrain $\mathbf{C}$: the comparison class must be a subset of the focus-alternative value of the sister of POS.

With these ingredients, Romero derives the two proportional readings (standard and reverse) from the single lexical entry for $\text{MANY}_{\text{prop}}$, as follows: on both readings, POS moves out of the DP to the sentence level. As is standard for QR in LF-based theories, POS leaves behind a trace (of type n in this case) that is bound by a lambda abstract created by the movement operation. That is, on both proportional readings, the sentence in (32a) has a logical form like the one sketched in (32b).

(32) a. Many Scandinavians vacation in the countryside.
b. $\big[[\text{POS } \mathbf{C}]\,\big[1\,\big[t_1\text{-MANY}_{\text{prop}}\,[\text{ Scandinavians }]\,[\text{ vacation in countryside }]\big]\big] \sim \mathbf{C}\big]$

What differs between the two readings is the focus structure of the sentence, which results in

[3] Romero's entry is more complicated because she also aims to decompose *few* into MANY, POS and an antonymizing morpheme LITTLE, *à la* Heim (2006). To achieve this, Romero uses the analysis from von Stechow (2009), according to which POS claims that its degree property argument is true of all degrees contained in the 'neutral segment' of the scale. This complication is not relevant for our purposes here.

[4] Romero takes the value delivered by θ to be dependent on the distribution of values over its comparison class argument, *cf.* Fernando and Kamp 1996; Schöller and Franke 2015.

different comparison classes. If the focus (or contrastive topic)[5] is outside of the restriction of the quantifier, a regular proportional reading results:

(33) Many Scandinavians vacation [in the countryside]$_{\mathbf{F}}$.

a. **Logical form:**
$\big[[\textsc{pos}\ \mathbf{C}]\ \big[1\ \big[t_1\text{-MANY}_{\text{prop}}\,[\text{ Scandinavians }]\,[\text{ vacation in countryside}_{\mathbf{F}}\ ]\big]\big] \sim \mathbf{C}\big]$

b. **Alternatives:**
$$[\![\mathbf{C}]\!] \subseteq \left\{ \begin{array}{llll} \lambda d'.d'\text{-MANY}_{\text{prop}}[& \text{Scandinavians} &][& \text{vacation in countryside} \quad], \\ \lambda d'.d'\text{-MANY}_{\text{prop}}[& \text{Scandinavians} &][& \text{vacation at the beach} \quad], \\ \lambda d'.d'\text{-MANY}_{\text{prop}}[& \text{Scandinavians} &][& \text{vacation in the mountains} \quad], \\ \lambda d'.d'\text{-MANY}_{\text{prop}}[& \text{Scandinavians} &][& \text{vacation in urban centers} \quad], \\ \ldots \end{array} \right\}$$

c. **Truth-conditions:**
$\exists d : d\text{-MANY}_{\text{prop}}[\text{ Scandinavians }][\text{ vacation in countryside }]\ \&\ d > \theta([\![\mathbf{C}]\!])$

d. **Paraphrase:**
The proportion of Scandinavians who vacation in the countryside is high compared to the proportion of Scandinavians vacationing in other places.

The reverse proportional reading emerges if the focus/contrastive topic instead occurs within the restrictor of *many*:

(34) Many [Scandinavians]$_{\mathbf{F}}$ vacation in the countryside.

a. **Logical form:**
$\big[[\textsc{pos}\ \mathbf{C}]\ \big[1\ \big[t_1\text{-MANY}_{\text{prop}}\,[\text{ Scandinavians}_{\mathbf{F}}\ ]\,[\text{ vacation in countryside }]\big]\big] \sim \mathbf{C}\big]$

b. **Alternatives:**
$$[\![\mathbf{C}]\!] \subseteq \left\{ \begin{array}{llll} \lambda d'.d'\text{-MANY}_{\text{prop}}[& \text{Scandinavians} &][& \text{vacation in countryside} \quad], \\ \lambda d'.d'\text{-MANY}_{\text{prop}}[& \text{Mainland Europeans} &][& \text{vacation in countryside} \quad], \\ \lambda d'.d'\text{-MANY}_{\text{prop}}[& \text{Americans} &][& \text{vacation in countryside} \quad], \\ \lambda d'.d'\text{-MANY}_{\text{prop}}[& \text{East Asians} &][& \text{vacation in countryside} \quad], \\ \ldots \end{array} \right\}$$

c. **Truth-conditions:**
$\exists d : d\text{-MANY}_{\text{prop}}[\text{ Scandinavians }][\text{ vacation in countryside }]\ \&\ d > \theta([\![\mathbf{C}]\!])$

d. **Paraphrase:**
The proportion of Scandinavians who vacation in the countryside is high compared to the proportion of people from other world regions who vacation in the countryside.

Romero's truth-conditions are not exactly those characterized in (28)–(29). For example, applying the semantics of (29) to (32a) would require that the ratio comparing Scandinavian countryside-vacationers to all countryside-vacationers worldwide is 'high'. (34) instead compares the ratio of Scandinavian countryside-vacationers to Scandinavians against the analogous ratio for other world regions. Romero argues that her truth-conditions are superior.[6]

[5]Romero leaves open whether stress marks focus (as assumed by Herburger 1997) or contrastive topic (as argued by Cohen 2001). We follow her in this regard, but to ease readability we will mark the stressed constituent with **F** rather than **F/CT**.

[6]Cohen (2001) argues that the number of all Scandinavians is relevant to the inverse proportional reading. To this, Romero adds examples showing that the individual alternative ratios must be taken into account. Whether or

5. The reverse reading as a relative reading of *most*

5.1. Our proposal

In a nutshell, our proposal is that the reverse reading of *most*-QICs arises as an instance of the relative reading of *most*/*-est*, which is analyzed in the manner of Heim (1999) and Hackl (2009). The only assumption that needs to be added is that the *if*-clause restricts the underlying 'parameterized determiner.' With this, the derivation of the reverse reading of *most*-QICs is entirely parallel to Romero's derivation of the reverse proportional reading of *many*.

(35a) repeats the definition of $\text{MANY}_{\text{card}}$. In (35b), we give a Heim (1999)-style meaning for *-est*. Following Romero's analysis, *-est* moves to the sentence level to gain scope. With focus in the *if*-clause, a restrictor analysis gives us the logical form sketched in (35c).[7]

(35) a. $\text{MANY}_{\text{card}} := \lambda d_n \lambda P_{et} \lambda Q_{et} . |P \cap Q| \geq d$
b. $[\![\text{-}est]\!] = \lambda \mathbf{C}_{dt,t} \lambda P_{dt} . \exists d \big[P(d) \,\&\, \forall C \in \mathbf{C} [C \neq P \rightarrow \neg C(d)] \big]$
c. Most students asked for calculators if they had to do [long divisions]$_{\mathbf{F}}$.
Logical form:
[[*-est* **C**] [1 [t_1-$\text{MANY}_{\text{card}}$ [kid & had to do [long division]$_{\mathbf{F}}$] [asked for calculator]]] $\sim$ **C**]

Again, **C** is required to be a subset of the focus-semantic value of the LF-sister of *-est*. This leads to a set of alternatives like (36), where *long divisions* contrasts with other problem types.

(36) **Alternatives:**

$$[\![\mathbf{C}]\!] \subseteq \left\{ \begin{array}{llll} \lambda d'.d'\text{-MANY}_{\text{card}}[& \text{kid} \;\&\; \text{had-to-do-long-division} &][\text{asked-for-calc}], \\ \lambda d'.d'\text{-MANY}_{\text{card}}[& \text{kid} \;\&\; \text{had-to-do-multiplication} &][\text{asked-for-calc}], \\ \lambda d'.d'\text{-MANY}_{\text{card}}[& \text{kid} \;\&\; \text{had-to-do-decimals} &][\text{asked-for-calc}], \\ \ldots \end{array} \right\}$$

The resulting truth-conditions are spelled out in (37a) and paraphrased in (37b):

(37) a. **Truth-conditions**:

$\exists d : d\text{-MANY}_{\text{card}}[\text{kid} \,\&\, \text{had-to-do-long-division}][\text{asked-for-calc}]$
$\wedge \forall C \in \mathbf{C} :$
$C \neq \lambda d'.d'\text{-MANY}[\text{kid} \,\&\, \text{had-to-do-long-division}][\text{asked-for-calc}] \rightarrow \neg C(d)$

b. **Paraphrase:**
The number of calculator-using kids who had to do long divisions was larger than the number of calculator-using kids doing any other problem type.

not this dependence on ratios needs to be part of the denotation of *many* is subject to debate. For example, Penka (2018) proposes that, semantically, all three readings are derived from a version of $\text{MANY}_{\text{card}}$, and that the apparent dependence on ratios in certain examples instead results from the way the function θ determines the standard on the basis of the comparison class. For our purposes, we can set this debate aside. We will be using $\text{MANY}_{\text{card}}$ in our analysis of *most*-QICs, remaining agnostic whether there is, in addition, a $\text{MANY}_{\text{prop}}$.

[7] In our LF-sketches, we add the content of the *if*-clause as a conjunct of the restrictor of $\text{MANY}_{\text{card}}$. This is done for ease of exposition only, and we do not intend to claim that *if*-clause is actually part of the first argument of the determiner. In fact, there are good reasons to think that any workable restrictor analysis must reject this possibility, as we discuss in Section 5.2 below.

The truth-conditions in (37) importantly differ from the ones in Section 2, repeated in (38):

(38) $|\text{calculator kids} \cap \text{long-division kids}| > |\text{calculator kids} - \text{long-division kids}|$

(37) characterizes a true relative reading, which only requires that the set of kids doing long divisions contained the largest group of calculator users. By contrast, (38) requires that more than half of the calculator users were long-divisioners. It is easy to see that the two readings can come apart in a situation where there are more than two problem types, namely if the largest group of calculator users for a given problem type is less than half of all calculator users. We think that the reading we derive is at least as appropriate as the alternative.[8]

This account correctly predicts that the reverse reading is only available when material in the *if*-clause is focused. More importantly, it also correctly predicts that this reading is only available for determiners that are focus-sensitive in the right way, and hence, unlike Kratzer's account, it does not predict the reverse reading for QICs with *every*.[9]

We do predict reverse readings for *many* and *few*, paraphrased in (39) and (40), respectively, on the assumption that these contain a Romero-style parameterized determiner. According to our intuitions, (39) and (40) are true in scenarios which satisfy their putative paraphrases. It is hard, however, to evaluate what this shows, given that with *many* (unlike with *most*), truth-value judgements are dependent on judgements of what counts as a 'high' number or proportion, relative to a comparison class.

(39) Many kids asked for calculators if they had to do [long divisions]$_{\mathbf{F}}$.
Putative 'reverse' reading:
The number/proportion of calculator users among the long-division kids was high compared to the number/proportion of calculator users doing other problem types.

(40) Few kids asked for calculators if they had to do [long divisions]$_{\mathbf{F}}$.
Putative 'reverse' reading:
The number/proportion of calculator users among the long-division kids was low compared to the number/proportion of calculator users doing other problem types.

5.2. *If*-clauses vs. relative clauses

Any restrictor account has to deal with the fact that QICs are not always equivalent to the analogous sentence where a relative clause replaces the *if*-clause. Our example sentences are a case in point: (41) has the vanilla reading, but does not have the reverse reading.

[8] Suppose the speaker has visited three classes of 20 children each. Each class did different kinds of problems: long division, logarithm and multiplication. 3 students in the logarithm class and 3 students in the multiplication class asked for calculators, and 8 students in the long division class did. To our ears, (35c) can be true in this situation, but we admit that the intuitions are somewhat subtle.

[9] Hallman (2016) proposes to analyze *all* as a superlative(-like) operator. Depending on the implementation, this analysis potentially predicts the reverse reading for a sentence like *All students asked for calculators if they had to do long divisions*.

(41) Most kids who had to do long divisions asked for calculators.

The absence of the reverse reading for (41) arguably can be attributed to a constraint that is independently needed (and hence motivated, see Romero 2015, 2016):

(42) **Constraint:** On a relative reading, the **F**-associate of *-est* cannot be internal to the DP where *-est* originates.

This constraint is active in examples with adjectival superlatives and *the most* (Pancheva and Tomaszewicz 2012):

(43) John has the best albums by $[\text{U2}]_{\mathbf{F}}$.
‘John has better albums by U2 than by any other band.’

(44) John has the most albums by $[\text{U2}]_{\mathbf{F}}$.
‘John has more albums by U2 than by any other band.’

Pancheva and Tomaszewicz (2012) provide an account of these facts. They also account for the fact that these readings actually are available in languages like Bulgarian and Polish as long as the DP where *-est* originates is not marked as definite. This explanation obviously does not directly translate to English DPs headed by *most* without a definite determiner, but the same constraint is needed for ‘bare’ *most* on any analysis that allows the determiner to have relative readings.[10] Otherwise, such accounts predict the analogue of the ‘reverse proportional’ reading of *many* for (45), contrary to fact:

(45) Most $[\text{Scandinavians}]_F$ have won the nobel prize in literature.
‘The number/proportion of Scandinavian NP-lit winners is larger than the number/proportion of NP-lit winners from any other world region.’

We want to suggest the following view. Even though in QICs, *if*-clauses restrict the quantifier in subject position, they are not ‘internal to the DP’ in the sense relevant to the constraint in (42), while relative clauses are. Thus, *if*-clauses allow speakers of English to circumvent the constraint and hence are the only environment where reverse readings of *most* can be produced.

Interestingly, as Romero (2016) notes, the putative ambiguity of the underlying parameterized determiner ($\text{MANY}_{\text{card}}$ VS $\text{MANY}_{\text{prop}}$) is obscured with *most* unless the focus falls within the restriction of the determiner. This means that, in English, QICs are are the only known environment where one could test whether there is a $\text{MOST}_{\text{prop}}$ ($\text{MANY}_{\text{prop}}$ + *-est*) in addition to $\text{MOST}_{\text{card}}$ ($\text{MANY}_{\text{card}}$ + *-est*). The crucial kind of scenario is given in (46).

[10]There is documented inter-speaker variation with respect to the acceptability of relative readings with bare *most*. Kotek et al. (2011, 2015) found evidence that only about a third of speakers could access a relative reading (which they dub the ‘superlative reading’). To our knowledge, no speakers perceive a reverse reading for (45).

(46) In a class of 35 students, 10 had to practice long division, the rest had to practice multiplication problems. 5 of the long division kids asked for calculators, while 7 of the multiplication kids did.

According to our intuitions, Kratzer's example does not seem to have a true reading in this scenario, i.e., there is no evidence for $\textsc{most}_{\text{prop}}$. This is in line what Romero reports for Bulgarian and Polish, where the difference between $\textsc{most}_{\text{card}}$ and (putative) $\textsc{most}_{\text{prop}}$ can be tested outside of conditionals as well.

5.3. Alternative accounts?

It might be thought that all that is needed to account for reverse readings is the basic idea underlying our analysis, *viz.*, that reverse readings are relative readings. With this, one might think, any analysis of relative readings of *most* and any analysis of QICs can be combined to account for reverse readings. But this is not so: the space of options is actually quite constrained.

Our account is built on a Romero/Hackl-style analysis of *most* which has several salient alternatives that may be preferable on independent grounds. Penka (2018) develops a more parsimonious version of Romero's account, insofar as she dispenses with the need for $\textsc{many}_{\text{prop}}$ in addition to $\textsc{many}_{\text{card}}$. Likewise, Beaver and Coppock (2014) provide an alternative analysis of *(the) most*, which Coppock and Josefson (2014) have argued is better equipped to handle the crosslinguistic variation in the distribution of the different readings of *(the) most*. What both these alternatives share in common is that they analyze *most* not as a 'parameterized determiner', but instead as a noun phrase modifier. As a consequence, it is not immediately obvious that these analyses can be combined with a restrictor analysis of QICs.

The problem is that the sentences in question must contain a quantifier for *if* to restrict. Penka's analysis, in theory, features such an operator, as she assumes that sentences with bare *most* receive their quantificational force from a silent existential determiner $\emptyset$. But it is not clear that it is plausible to assume that *if*-clauses restrict $\emptyset$ in our examples, because quantifiers headed by *overt* existential determiners generally cannot be restricted by *if*-clauses: *Some students passed if they studied hard* does not have a reading on which it says that there are some students that both studied hard and succeeded. Things are even worse on Beaver and Coppock's account, where there is no quantificational operator in the structure of sentences with definites and indefinites (including *the most*)—instead, these DPs gain quantificational force (or reference) via a type-shifting operation when they are in argument position. As a consequence, it is not clear how a restrictor analysis would combine with their account. This is not to say that either of these accounts could not be made compatible with a restrictor analysis, suitably spelled out. Maybe Penka's $\emptyset$ is different from overt existentials in a way that allows it to be restricted by *if*-clauses. Likewise, a suitable specification of the syntax-semantics interface could allow *if*-clauses to restrict the output of the type shifting operation in Beaver and Coppock's account.[11] All that we want to note here is that such a combination will not work 'out of the box.'

[11] Alternatively, Beaver and Coppock allow for the possibility that bare *most* is a an operator that is not derivationally related to the *most* in *the most*-DPs. This *most* could be a *bona fide* determiner, which *if* could restrict.

Proponents of such alternative accounts may hence be especially interested in alternative accounts of QICs. Unfortunately, such alternatives do not seem workable to us. Let MOST_{rel} be an arbitrary account of relative *most*, and suppose that QICs have a full conditional structure embedded under the quantifier, as in (47):

(47) MOST_{rel} [kids] [had to do long divisions $\triangleright$ asked for calculators]

In order to derive the truth conditions we derive, MOST_{rel} has to compare the number of calculator users that had to do long division in relation to the number of calculator users that had to do other problem types. The question is how it can do that on an analysis like (47) without assuming that *if . . . then* can mean *and* when embedded under a quantifier.

6. Conclusion and outlook

We have shown that the reverse reading does not provide an insurmountable challenge for a restrictor analysis of QICs. On the contrary, on a restrictor analysis, the reverse reading emerges rather straightforwardly as an instance of the relative reading of *most*, given a number of independently motivated ingredients. Some open issues remain.

Empirically, it is worth noting that not all speakers can access the reverse reading in *most*-QICs. Even those that can perceive the reading, do so only under favorable circumstances. This is not entirely unexpected on our account, as it has been shown (e.g., Kotek et al., 2015) that only a subset of speakers can access relative readings with bare *most*, and that even for those speakers, this reading is not dominant. Our account of the reverse reading makes a clear prediction that lends itself to experimental testing: The speakers who can access reverse readings of *most*-QICs should be the same ones that perceive relative readings with *most* more generally.

Theoretically, while Leslie's extended restrictor analysis is promising, it remains to be seen whether it can be spelled out in a way that deals with all challenges that have been identified in the literature. An additional question is why the presence of an *if*-clause restricting a nominal quantifier forces the presence of a wide-scope modal. At the same time, the interaction of *if*-clauses, the putative wide-scope modal, and tense deserves closer attention. Kratzer notes that some of the problematic differences between *if*-clauses and relative clauses disappear in the past tense. For example, consider the pair in (48). (48a) appears to quantify not only over actual goofers, but also students who *could* goof off, even though in actuality they do not (Leslie 2009). (48b), by contrast, only makes a claim about students who actually goofed off.

(48) a. Every student will fail if she goofs off.
b. Every student failed if she goofed off.

This contrast can arguably be accounted for if the wide-scope modal in Leslie's analysis quantifies over *historical alternatives* at the utterance time (Condoravdi, 2002). This quantification is trivialized in the past-tense, but not in the present and the future. More generally, we conjecture that many, if not all, apparent challenges for a restrictor analysis can be explained by a combination of (i) the presence of a wide-scope modal, (ii) temporal interpretation, and (iii) the fact that domain restriction proceeds differently with *if*-clauses than with relative clauses. We intend to investigate the details of this idea in future work.

Open issues notwithstanding, we think that the existence of reverse readings (for some speakers) evens the score a bit: As noted in Section 5.3, it is not at all clear that non-restrictor accounts can analyze reverse readings as relative readings. Such accounts consequently face the challenge of how to predict these readings in a way that accounts for their distribution across determiners. As we have shown, restrictor accounts succeed on this front: hence, even skeptics should agree that they deserve another look.

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The number sensitivity of modal indefinites[1]

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Abstract. In this study, I take up the interaction between modal flavor and the number morphology of existential *wh*-indefinites in Mandarin, a phenomenon first discussed in Lin (1998). I argue that there are three essential theoretical pieces to this interaction: (i) types of nominal reference (quantized vs. cumulative), (ii) degrees of modal variation (total vs. partial), and (iii) achieving modal variation by exhaustification. I show that while exhaustifying alternatives contributed by quantized *wh*-indefinites may give rise to either total or partial modal variation, exhaustifying alternatives contributed by cumulative *wh*-indefinites may only give rise to partial modal variation.

Keywords: alternatives, exhaustification, modal indefinites, plurality

1. Introduction

Indefinites that give rise to modal inferences are called modal indefinites. Well-known examples of modal indefinites include those introduced by determiners like English *any* (Kadmon and Landman 1993, Dayal 1998, Chierchia 2013, a.o.) German *irgendein* (Kratzer and Shimoyama 2002, a.o.,) Spanish *algún* (Alonso-Ovalle and Menéndez-Benito 2010) and Romanian *vreun* (Fălăus 2014). Take German *irgendein* indefinites as an example. They give rise to different modal inferences under the scope of epistemic modals and deontic modals (Aloni and Port 2010, Aloni and Franke 2013), as exemplified by (1) and (2) (taken from Aloni and Franke 2013). Specifically, in (1), the *irgendein* indefinite is in the scope of a deontic modal, and it gives rise to an inference that any man can be a marriage option for Mary; by contrast, in (2), the *irgendein* indefinite is in the scope of an epistemic modal, and it leads to an inference that signals speaker ignorance or indifference.

(1) Mary musste irgendeinen Mann heiraten.
Mary had-to irgend-one man marry
'Mary had to marry a man.'
⇝ Any man was a permitted marriage option for Mary.

(2) Juan muss in irgendeinem Zimmer im Haus sein.
Juan must in some room in-the house be
'Juan must be in some room of the house'
⇝ The speaker does not know or does not care about which room Juan is in.

Aloni and Franke (2013) called the inference in (1) 'total variation inference,' and the inference in (2) 'partial variation inference.' These terms are based on the Modal Variability Hypothesis, which attributes distinct degrees of modal variation to epistemic and deontic modals (see also Aloni and Port 2010). According to Aloni and Franke (ibid), *deontic modals require total*

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modal variation, but epistemic modals only require partial modal variation, where total and partial modal variations are defined below (Aloni and Franke 2013:110): [2]

(3) a. Total (modal) variation: $\forall x \diamond \phi(x)$
All alternatives in the relevant domain qualify as a possible option.
b. Partial (modal) variation: $\exists x \exists y(\diamond\phi(x) \wedge \diamond\phi(y) \wedge x \neq y)$
More than one (but not necessarily all) alternatives in the relevant domain qualify as a possible option.

The inference in (1) clearly follows the definition of total variation. The inference in (2) is identified as partial variation, because it is felicitous in the 'hide and seek' scenario described by Alonso-Ovalle and Menéndez-Benito (2010).

(4) María, Juan, and Pedro are playing hide-and-seek in their country house. Juan is hiding. María and Pedro haven't started looking for Juan yet. Pedro believes that Juan is not hiding in the garden or in the barn: he is sure that Juan is inside the house. Furthermore, Pedro is sure that Juan is not in the bathroom or in the kitchen. As far as he knows, Juan could be in any of the other rooms in the house.

In the above scenario, Pedro can felicitously utter (2), even though not all the rooms are epistemic possibilities for him—he knows that Juan is not in the bathroom or in the kitchen.

In this paper, I extend this line of research to include modal indefinites in Mandarin. I demonstrate that the distinction in total vs. partial modal variation has a reflex on the number morphology of modal indefinites. Adopting the Alternatives and Exhaustification approach outlined in Chierchia (2013), I show that total modal variation is not compatible with domain alternatives triggered by a modal indefinite that exhibit cumulative reference in the sense of Krifka (1989, 1998). This analysis is able to account for a long standing puzzle in Mandarin, i.e., a modal indefinite must occur with a numeral classifier under the scope of deontic modals (Lin 1998).

This paper is organized as follows. Section 2 introduces the core data and clarifies the correlation between modal flavor and degrees of modal variation. Section 3 provides an account for the interaction, which incorporates plurality into the framework of Alternatives and Exhaustification (Chierchia 2013, Fox 2007, a.o.). Section 4 concludes.

2. Modal indefinites in Mandarin

Mandarin makes use of *wh*-phrases, rather than a distinct determiner, to construct modal indefinites (Lin 1998, see also Li 1992). Consider the example in (5). This sentence makes an existential claim, but additionally conveys a modal inference that the speaker does not know

[2] As a terminological note, the term *total (modal) variation* is often taken to be synonymous with *free choice*, while the term *partial (modal) variation* is often simply referred to as *modal variation*, after Alonso-Ovalle and Menéndez-Benito (2010). I take modal variation to be a cover term for both total and partial modal variation in this paper.

which book(s) Zilu read.[3] Due to the modal inference, the speaker of (5) may not identify the book, whether by its name or its physical ostension, as suggested by the infelicity of the 'namely' continuation (see also Liao 2011: 8–9). The same infelicity is not shared by an ordinary indefinite, which lacks the modal inference, as shown in (6).

(5) Zilu **keneng**$_E$ kan-le *shenme* shu. # Jiushi Halibote.
Zilu possibly read-ASP what book namely Harry.Potter
'Zilu possibly read some book(s), namely *Harry Potter*.'

(6) Zilu **keneng**$_E$ kan-le <u>yi-ben</u> shu. Jiushi Halibote.
Zilu possibly read-ASP <u>one-CL</u> book namely Harry.Potter
'Zilu possibly read a book, namely *Harry Potter*'

In addition, Mandarin *wh*-indefinites can also occur within the scope of deontic modals (subscripted with *D*), as exemplified in (7). Intuitively, this sentence conveys that any book in a contextual relevant set can be an option for Zilu.

(7) Zilu **keyi**$_D$ du yi-ben *shenme* shu.
Zilu can read one-CL what book
'Zilu can read any book.'

Based on this set of data, Liao (2011) argues that *wh*-indefinites in Mandarin should be taken to be modal indefinites. She proposes an analysis based on Alternatives and Exhaustification (Chierchia 2006, 2013, Fox 2007) to capture the modal variation effect and the fact that modals are required for these *wh*-indefinites to be well-formed.

Mandarin *wh*-indefinites are similar to German *irgendein* indefinites in their interactions with modals with different flavors. Specifically, a *wh*-indefinite under an epistemic modal expresses partial modal variation, but the same indefinite under a deontic modal expresses total modal variation. This contrast is verified by the following contexts.

Context 1: Total variation
John and Mary were planning a trip to Europe. John suggested:

(8) Women **keyi**$_D$ qu yi-ge Ouzhoude <u>shenme</u> chengshi.
we can go one-CL European what city
'We can go to an European city (whichever will work).'

Mary knew that they could only visit an European city where they had a friend to stay with. Since they only had a friend in London and a friend in Berlin, she added:[4]

[3]Mandarin lacks plural morphology, so depending on the context Zilu could have read one or more books. This property of bare noun phrases is central to the discussion of this paper.

[4]I chose not to narrow down the domain to a single city so that it can be clear that the objection is not to the lack of modal variation, but to how freely one can choose among the cities in Europe.

(9) Bu dui. Women zhi **keyi**$_D$ qu Lundun huo Bolin.
no right we only can visit London or Berlin.
'No, we can only go to London or Berlin.'

Mary's response is felt to be *felicitous* in this context. Under the deontic modal, which requires total modal variation, the sentence in (8) expresses that all the cities in Europe that are in the domain are open options for their visit. This total modal variation inference can be challenged by a denial, as shown in (9).

Context 2: Partial variation
John and Mary knew that Peter went on a trip last week, but they did not know where he went. They were talking about where Peter could have gone. John suggested:

(10) Ta **keneng**$_E$ qu-le yi-ge Ouzhoude shenme chengshi.
he possibly go-ASP one-CL European what city
'He could have gone to an European city.'

Mary knew that Peter stayed with a friend during his trip, and Peter only had two overseas friends, one in London and one in Berlin. So, she added:

(11) #Bu dui. Ta zhi **keneng**$_E$ qu-le Lundun huo Bolin.
not right he only possible go-ASP London or Berlin
'No, he could only have gone to London or Berlin.

This time, the response is felt to be *infelicitous*. Although modal variation is still perceived with (10), partial modal variation is enough for the epistemic environment. This means that not necessarily all European cities in the domain are taken into consideration. In this case, challenging total modal variation is not felicitous, because no total modal variation inference is generated. I argue that this is the reason why the response is odd.[5]

Although Mandarin *wh*-indefinites have modal variation inferences similar to German *irgendein* indefinites, they show a lesser known and intriguing interaction between the types of licensing modals and numeral classifiers in *wh*-phrases. In particular, as observed by Lin (1998), modal *wh*-indefinites under deontic modals must be accompanied by a numeral classifier (underlined), as evidenced by (12), whereas epistemic modals are compatible with *wh*-phrases

[5] A limitation of this diagnostic is that the contrast fails to hold between deontic and epistemic necessity modals. Using English as an example, we can see that (ib) is way more natural as a objection to (ia) than (iib) is to (iia):

(i) a. A: John may read a book from the shelf.
b. B: No. He may not read *Harry Potter*.

(ii) a. A: John must read a book from the shelf.
b. B: # No. He may not read *Harry Potter*.

with or without numeral classifiers, as illustrated by the well-formedness of (13).[6] This generalization is true regardless of the modal force.

(12) Zilu **yao$_D$/keyi$_D$** kan *(yi-ben) *shenme* shu.
Zilu must/can read one-CL what book
'Zilu must/can read some book(s) (I don't care which).'

(13) Zilu **kending$_E$/keneng$_E$** kan-le (yi-ben) *shenme* shu.
Zilu certainly/possibly read-ASP one-CL what book
'Zilu possibly read some book(s) (I don't know which).'

Represented configurationally, the classifier puzzle has the following form:

(14) a. Epistemic modal ... (NUM-CL) *wh*-phrase
b. Deontic modal ... *(NUM-CL) *wh*-phrase

Combining the terminology used in the literature of bare noun phrases and modal indefinites, I refer to existential *wh*-indefinites without numeral classifiers as 'bare *wh*-indefinites'. In contrast, I refer to existential *wh*-indefinites with numeral classifiers as 'non-bare *wh*-indefinites'.

In this paper, I develop an account for the classifier puzzle, couched primarily in the Alternatives and Exhaustification approach (Chierchia 2006, 2013, Liao 2011, a.o.), but incorporates insights from research on nominal reference (Link 1983, Krifka 1989, a.o.). Assuming that *wh*-indefinites are translated as existential quantifiers (Karttunen 1977), I argue that it is possible to tease apart bare and non-bare *wh*-indefinites in terms of their domain restrictions. The former are restricted by nominal predicates which denote sets containing atomic and plural individuals closed under sum formation. Following the classical terminology, we say that this type of predicates exhibit *cumulative reference*. The latter are restricted by nominal predicates whose denotations are not closed under sum formation. These predicates are known to exhibit *quantized reference*. The cumulativity-quantization distinction goes back at least to Link (1983) (who credits Quine 1960 for cumulativity) and is discussed in detail by Krifka (1989). In addition, I adopt an emerging view from the literature of modal variation that epistemic modals and deontic modals have different free choice potentials (see Aloni and Port to appear b, Fălăus 2014). Once this contrast is in place, we can see that *wh*-indefinites under epistemic modals express *partial modal variation*, while those under deontic modals express *total modal variation*.

After incorporating the distinctions between cumulativity vs. quantization and between total vs. partial modal variation, an analysis based on Alternatives and Exhaustification reveals the source of the classifier puzzle. Specifically, deriving total modal variation with a modal indefinite restricted by a cumulative predicate results in a contradictory inference. This contradiction can be avoided in two ways, either by replacing a cumulative predicate (i.e., a bare

[6] Some aspect markers on verbs that are available under epistemic modals are not so under deontic modals. *Le* is such an example. At this stage, it's not clear to me whether this difference in aspect marking is related to the classifier puzzle.

wh-indefinite) with a quantized predicate (i.e., a non-bare *wh*-indefinite), or by lowering the degree of modal variation. The former explains why numeral classifiers can help deontic modals 'license' *wh*-indefinites. The latter accounts for the optionality of numeral classifiers with *wh*-indefinites in epistemic modal environments.

3. An Alternatives and Exhaustification approach to modal variation

3.1. Key ingredients

My proposal is based on the Alternatives and Exhaustification approach initiated by Chierchia (2006, 2013) and Fox (2007), and especially follows the extension of these studies to Mandarin *wh*-indefinites by Liao (2011). Following these studies, a modal indefinite is taken to be an implicature trigger with a bi-dimensional denotation. An exhaustification operator makes use of this bi-dimensional denotation, giving rise to a modal inference and conditioning the distribution of the modal indefinite.

Concretely, a *wh*-indefinite in the form of *shenme shu* 'what book' is an generalized quantifier with a covert quantificational determiner $\exists$ (cf. Karttunen 1977), as shown in (15a). Following Hamblin (1973) and recent works on Alternative Semantics (e.g., Kratzer and Shimoyama 2002), I take this *wh*-NP to denote a set of alternative individual books. For instance, in a model with two books a and b, this *wh*-NP denotes the set $\{\mathsf{a},\mathsf{b}\}$, as illustrated in (15b).

(15) a. $[_{\text{DP}}\ \exists\ [_{\text{NP}}\ \text{what book}]]$
b. $[\![\text{what book}]\!] = \{x \mid \mathsf{book_w}(x)\} = \{\mathsf{a},\mathsf{b}\}$

Combining the existential operator with the *wh*-NP gives rise to the ordinary denotation of the *wh*-indefinite, which is a generalized existential quantifier, as shown in (16a). In addition, it has a special, focus-like denotation, which is a set of alternatives to the ordinary denotation (16b).

(16) a. $[\![\text{DP}]\!] = \lambda Q.\lambda w.\exists x[x \in [\![\text{what book}]\!] \wedge Q_w(x)]$
b. $[\![\text{DP}]\!]^{\text{A}} = \{\lambda Q.\lambda w.\exists x[x \in D' \wedge Q_w(x)] : D' \subset [\![\text{what book}]\!] \wedge D' \neq \emptyset\} \bigcup$
$\{\lambda Q.\lambda w.\forall x[x \in [\![\text{what book}]\!] \rightarrow Q_w(x)]\}$

The alternative set consists of two different kinds of alternatives. The first one is *domain alternatives*. They are alternatives constructed from *non-empty proper subsets* of a quantificational domain, as shown in (17a). If the domain contributed by $[\![\text{what book}]\!]$ has two atomic books, as suggested by (15b), then the set of domain alternatives has two members, each a proper subset of this domain, as exemplified in (17b).

(17) a. $[\![\text{DP}]\!]^{\text{DA}} = \{\lambda Q.\lambda w.\exists x[x \in D' \wedge Q_w(x)] : D' \subset [\![\text{what book}]\!] \wedge D' \neq \emptyset\}$
b. $\{D' : D' \subset \{\mathsf{a},\mathsf{b}\}\} = \{\{\mathsf{a}\},\{\mathsf{b}\}\}$

The second variety is the *scalar alternative*. Following Chierchia (2013), it is determined by replacing existential quantification in the ordinary denotation with universal quantification.[7]

[7] Alonso-Ovalle (2008) has offered a different mechanism for deriving scalar alternatives, which crucially relies

These two types of alternatives have to be operated on by an alternatives-sensitive operator, often abbreviated as $\mathbb{O}$ (after *only*, or **Exh** (after *exhaustification*)). Based on Chierchia (2013), I offer the following lexical entry for $\mathbb{O}$:

(18) a. $[\![\mathbb{O}\ S]\!] = \lambda w[[\![S]\!](w) \wedge \forall q \in [\![S]\!]^{\text{Exh-Alt}}[q \rightarrow \lambda w'[\![S]\!](w') \subseteq q]]$
b. $[\![S]\!]^{\text{Exh-Alt}} = \{\mathbb{O}_{\text{IE}}(p) : p \in [\![S]\!]^{\text{A}}\}$

This is often known as a 'recursive' exhaustification operator. When applying to a sentence *S*, it first applies pointwise to the set of alternatives of *S*, generating a set of pre-exhaustified alternatives, as done in (18b). Note that pre-exhaustification is subject to a condition called 'Innocent Exclusion' (Fox 2007, see also Sauerland 2004), which is defined below:

(19) a. $\text{IE-ALT}_{\text{p}} = \cap\{X \subseteq ALT : CONS(p \wedge \neg\cap X) \wedge \forall q \in ALT[CONS(p \wedge \neg\cap X \wedge \neg q) \rightarrow q \in X]\}$, where $CONS(p) = p$ is consistent
b. $\mathbb{O}_{\text{IE}}(p) = p \wedge \forall q \in ALT[(q \in \textit{IE-ALT}_p \wedge p \not\subseteq q) \rightarrow \neg q]$

The role of Innocent Exclusion in pre-exhaustification is to avoid excluding alternatives that may lead to contradictory inferences. Each pre-exhaustified alternative that is not entailed by the assertion is negated, helping to generates a strengthened assertion.[8]

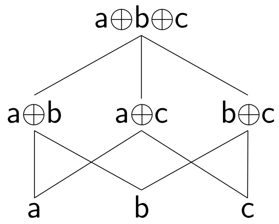
With the mechanism to derive alternatives and the operator that operates on alternatives, this approach derives the ill-formedness of *wh*-indefinites when they are not in the scope of a modal as a logical contradiction. Since explaining the modal requirement is not the primary concern of this paper, I refer the reader to Liao (2011) and Chierchia (2013) for detailed discussions on this point. How modal variation is achieved can be found in Section 3.3.

3.2. Pluralities

Since the seminal work of Link (1983), it has been well accepted into the semantic literature that (i) the domain of individuals (D_e) consists of both atomic and plural individuals, (ii) plural individuals are sums of atomic individuals or sums of other plural individuals, and (iii) D_e is closed under sum formation. For example, a domain with three atomic individuals a, b, and c have the following mereological structure ($\oplus$ is the sum formation operator; each line represents a partial order):

on Alternative Semantics.

[8] Two notes on the exhaustification operator. First, it is based on Chierchia (2013) but differs from it in having the exhaustification of scalar alternatives and the exhaustification of domain alternatives merged, for the purpose of simplification. Second, it differs from Fox's (2007) exhaustification operator in being able to lead to contradictions. It is worth noting that whether an exhaustification operator with an innocent exclusion component should be contradiction-free is subject to debate. For instance, while Fox (2007) argues for the desirability of a contradiction-free exhaustification operator, Gajewski (2012) and Chierchia (2013) point out a few merits for allowing an exhaustification operator to derive contradictions. For Chierchia (2013), one of these merits is that it explains why modal indefinites have a restricted distribution in many languages: they are illegitimate precisely when contradictory inferences are induced.



Following Link (1983), Schwarzschild (1996) and many others, I assume that noun phrases with distinct number morphologies have different denotations. Take noun phrases in English as an example. A singular count noun like *book* denotes a subset of D_e, which contains only atomic books. For instance, if a and b in D_e are books, then the denotation of *book* is as shown in (20a). By contrast, a bare plural noun like *books* denotes as its extension a set involving the atomic books **as well as their sums**, as in (20b).

(20) a. $[\![\text{book}]\!] = \{\mathsf{a}, \mathsf{b}\}$
b. $[\![\text{books}]\!] = \{\mathsf{a}, \mathsf{b}, \mathsf{a} \oplus \mathsf{b}\}$

According to Krifka (1989) (see also Quine 1960, Link 1983), these two types of predicates differ in terms of nominal reference. A predicate has *cumulative reference* iff, when it holds of two distinct individuals, it also holds of their sums (Krifka 1989:78, D12). Obviously, the bare plural *books* has cumulative reference, since the sum of any two books still belongs to the denotation of *books*. On the contrary, a predicate has *quantized reference* iff, when it holds of an individual, it doesn't hold of any proper subparts thereof (Krifka 1989:78, D14). The singular count noun *book* has quantized reference, since the sum of a and b is not in the denotation of *book*. Likewise, in English predicates with numerals like *two books* are also quantized (despite being plural), because a collection of two units of *two books* results in *four books*, rather than *two books*.

Chierchia (1998) argues that Mandarin bare nouns, which lack plural morphology, share the same type of denotation with English bare plurals. In other words, the denotation of *shu* 'book' is comparable to that of *books* (see also Yang 2001; Jiang 2012), ignoring the implicature associated with the plural morphology (Krifka 1989, Sauerland 2003). This view, which is rather standard in the current literature, meets the empirical requirement that *shu* may refer to one or more books in Mandarin. Hence, we can conclude that Mandarin bare nouns exhibit cumulative reference. To create quantized predicates, the use of a numeral classifier is needed. In this regard, the function of numeral classifiers is very similar to the function of numerals in English—they both create quantized predicates.[9] It is easy to demonstrate that nouns with numeral classifiers are quantized: the sum of two units of *yi-ben shu* 'one book' is not *yi-ben shu*, but *liang-ben shu* 'two books'.

[9] In the neo-Carlsonian approach, bare nouns are kind terms and numeral classifiers are lexical predicativizers that help bring a kind term to its predicate use (Krifka 1995, Chierchia 1998, Yang 2001). This view is entirely compatible with the cumulativity-quantization distinction defended here, as long as we bring in the type-shifters that are part and parcel in the neo-Carlsonian approach. However, to avoid complicating the semantic composition, I omit the derivation of bare nouns from kind terms to predicates and assume that bare nouns start out as predicates.

I argue that the cumulativity-quantization distinction can be extended to *wh*-indefinites. In particular, bare *wh*-indefinites are cumulative predicates while non-bare *wh*-indefinites are quantized predicates. Recall that a *wh*-phrase provides the quantificational domain for a covert existential quantifier (see Section 3.1). As shown in (21), the existential determiner quantifies over individuals restricted by *books*, which is cumulative. Assume that there are two atomic books, a and b. The denotation of *shenme shu* 'what books' is a set of alternative books closed under sum formation, as illustrated in (21a). The bi-dimensional denotation of the *wh*-indefinite is derived as (21b) and (21c).

(21) a. $[\![\text{what books}]\!] = \{x \mid \text{books}_{\mathsf{w}}(x)\} = \{\mathsf{a}, \mathsf{b}, \mathsf{a} \oplus \mathsf{b}\}$

b. $[\![\exists \text{ what books}]\!] = \lambda Q.\lambda w.\exists x[x \in [\![\text{what books}]\!] \wedge Q_w(x)]$

c. $[\![\exists \text{ what books}]\!]^{\mathrm{A}} = \{\lambda Q.\lambda w.\exists x[x \in D' \wedge Q_w(x)] : D' \subset [\![\text{what books}]\!]\} \bigcup \{\lambda Q.\lambda w.\forall x[x \in [\![\text{what books}]\!] \rightarrow Q_w(x)]\}$

After putting the bare *wh*-indefinite in a sentential context, the bi-dimensional meaning in (22) is obtained (the propositional correlates of the individuals are set in boldface). The underlined parts represent the extra contribution of the cumulative nominal predicate after plurality is brought into the picture.

(22) a. $[\![\text{Zilu read what books}]\!] = \mathbf{a} \vee \mathbf{b} \vee \underline{\mathbf{a} \oplus \mathbf{b}}$

b. $[\![\text{Zilu read what books}]\!]^{A} = \{\underline{\mathbf{a} \vee \mathbf{b}}, \mathbf{a}, \mathbf{b}, \underline{\mathbf{a} \oplus \mathbf{b}}, \mathbf{a} \wedge \mathbf{b}\}$

Note that the assertion in (22a) has an additional disjunct, contributed by the plural individual in the domain (21a). Since the domain alternatives are derived from the proper subsets of the domain, the addition of the plural individual to the domain has non-trivial effects on the set of domain alternatives. Specifically, there is a *weakest alternative*, i.e., $\mathbf{a} \vee \mathbf{b}$, which is truth-conditionally equivalent to the assertion $\mathbf{a} \vee \mathbf{b} \vee \mathbf{a} \oplus \mathbf{b}$. In addition, there is a *strongest alternative*, in this case $\mathbf{a} \oplus \mathbf{b}$, which is truth-conditionally equivalent to the scalar alternative $\mathbf{a} \wedge \mathbf{b}$, when lexical distributivity is assumed. Throughout this paper, I assume lexical distributivity and hence the equivalence of the maximal alternative and the scalar alternative. Whenever the maximal alternative is present, I suppress the scalar alternative.

Now, I turn to non-bare *wh*-indefinites, i.e., those with numeral classifiers. Like bare existential *wh*-phrases, a covert determiner $\exists$ is still posited for this type of expression. The structure of *yi-ben shenme shu* 'one-CL what books' is (23).

(23) $[_{\text{DP}} \exists [_{\text{NP}} \text{one-CL what books}]]$

Just like (21a), *shenme shu* 'what books' denotes a set of alternative individual books including both atomic and plural individuals. This is repeated in (24a). A numeral classifier serves as a function that can select a subset from a set. The denotation of the numeral classifier under consideration is formulated as in (24b). It takes the set denoted by *what books* as an argument and returns a set whose only members are those in $[\![\text{what books}]\!]$ and have one atomic part.[10] As shown in (24c), the denotation of NP essentially *excludes the maximal individual* from

[10]Following the notation in Landman (2004), the function ATOM maps an individual to its atomic parts.

$[\![$what books$]\!]$, giving rise to a quantized predicate. Finally, the denotation of DP is represented in (24d) and the set of its alternatives is shown in (24e).[11]

(24) a. $[\![\text{what books}]\!] = \{x \mid \text{books}_{\mathsf{w}}(x)\} = \{\mathsf{a}, \mathsf{b}, \mathsf{a} \oplus \mathsf{b}\}$
b. $[\![\text{one-CL}]\!] = \lambda D\{x \mid x \in D \wedge |\text{ATOM}(x)| = 1\}$
c. $[\![\text{NP}]\!] = \{x \mid x \in [\![\text{what books}]\!] \wedge |\text{ATOM}(x)| = 1\}$
d. $[\![\text{DP}]\!] = \lambda Q.\lambda w.\exists x[x \in [\![\text{what books}]\!] \wedge |\text{ATOM}(x)| = 1 \wedge Q(x)]$
e. $[\![\text{DP}]\!]^{\text{A}} = \{\lambda Q.\lambda w \exists x[x \in D' \wedge |\text{ATOM}(x)| = 1 \wedge Q_w(x)] : D' \subset [\![\text{what books}]\!]\} \bigcup$
$\{\lambda Q.\lambda w \forall x[x \in [\![\text{what books}]\!] \wedge |\text{ATOM}(x)| = 1 \rightarrow Q_w(x)]\}$

The difference between this example and the case with a bare *wh*-indefinite is most clearly seen in a sentential context. Consider a sentence with a non-bare *wh*-indefinite:

(25) a. $[\![\text{Zilu read one-CL what books}]\!] = \mathbf{a} \vee \mathbf{b}$
b. $[\![\text{Zilu read one-CL what books}]\!]^{A} = \{\mathbf{a}, \mathbf{b}, \mathbf{a} \wedge \mathbf{b}\}$

A noticeable difference is that the maximal individual $\mathbf{a} \oplus \mathbf{b}$ is no longer part of the ordinary denotation. Relatedly, it is also absent in the set of alternatives.

3.3. Deontic modals: contradiction and repairing

This section answers the first part of the classifier puzzle, namely, why deontic modals militate against bare *wh*-indefinites. Consider the following ill-formed sentence:

(26) *Zilu **keyi**$_D$ kan *shenme* shu.
Zilu may read what book
'Zilu may read some book(s) (I don't care which).'

In the Alternatives and Exhaustification approach, the interaction of epistemic modals and modal indefinites is captured by recursively applying the exhaustification operator $\mathbb{O}$ (Fox 2007, Liao 2011, Chierchia 2013). Therefore, the LF structure of (27) can be represented as follows:

(27) *$[_{\text{IP4}}\ \mathbb{O}\ [_{\text{IP3}}\ \textbf{may}_D\ [_{\text{IP2}}\ [_{\text{DP}}\ \exists\ [\text{what books}]]_1\ [_{\text{IP1}}\ \text{Zilu}\ [_{\text{VP}}\ \text{read}\ t_1]\ ]\ ]\ ]\ ]$

The bi-dimensional denotation of IP2 is equivalent to example (22), i.e., (28). Then, the denotation of IP3 incorporates the contribution of the modal ($[\diamond]$ is a shorthand for a deontic possibility modal), as illustrated in (29).

(28) a. $[\![\text{IP2}]\!] = \mathbf{a} \vee \mathbf{b} \vee \mathbf{a} \oplus \mathbf{b}$
b. $[\![\text{IP2}]\!]^{\text{A}} = \{\mathbf{a} \vee \mathbf{b}, \mathbf{a}, \mathbf{b}, \mathbf{a} \oplus \mathbf{b}, \mathbf{a} \wedge \mathbf{b} \wedge \mathbf{a} \oplus \mathbf{b}\} = \{\mathbf{a}, \mathbf{b}, \mathbf{a} \vee \mathbf{b}, \mathbf{a} \oplus \mathbf{b}\}$

[11] I have ignored the potential scalar alternatives associated with the numeral.

(29) a. $[\![\text{IP3}]\!] = [\diamond](\mathbf{a} \vee \mathbf{b} \vee \underline{\mathbf{a} \oplus \mathbf{b}})$
b. $[\![\text{IP3}]\!]^{\text{A}} = \{[\diamond](\mathbf{a} \vee \mathbf{b}), [\diamond]\mathbf{a}, [\diamond]\mathbf{b}, [\diamond](\mathbf{a} \oplus \mathbf{b})\}$

Recall that combining $\mathbb{O}$ and IP3 requires the affirmation of the assertion of IP3 and the negation of all the pre-exhaustified alternatives of IP3. The assertion of IP3 is given in (30a) and the set of pre-exhaustified alternatives is given in (30b) and elaborated in (30bi)–(30biv). Note in (30biv) that pre-exhaustifying the maximal alternative returns itself, as this alternative is the strongest member in the set.

(30) a. $[\![\text{IP3}]\!] = [\diamond](\mathbf{a} \vee \mathbf{b} \vee \mathbf{a} \oplus \mathbf{b})$
b. $[\![\text{IP3}]\!]^{\text{Exh-Alt}} = \{\underline{\mathbb{O}[\diamond](\mathbf{a} \vee \mathbf{b})}, \mathbb{O}[\diamond]\mathbf{a}, \mathbb{O}[\diamond]\mathbf{b}, \underline{\mathbb{O}[\diamond]\mathbf{a} \oplus \mathbf{b}}\}$
(i) $\mathbb{O}[\diamond](\mathbf{a} \vee \mathbf{b}) = [\diamond](\mathbf{a} \vee \mathbf{b}) \wedge \neg[\diamond]\mathbf{a} \oplus \mathbf{b}$
(ii) $\mathbb{O}[\diamond]\mathbf{a} = [\diamond]\mathbf{a} \wedge \neg[\diamond]\mathbf{b} \wedge \neg[\diamond]\mathbf{a} \oplus \mathbf{b}$
(iii) $\mathbb{O}[\diamond]\mathbf{b} = [\diamond]\mathbf{b} \wedge \neg[\diamond]\mathbf{a} \wedge \neg[\diamond]\mathbf{a} \oplus \mathbf{b}$
(iv) $\mathbb{O}[\diamond]\mathbf{a} \oplus \mathbf{b} = [\diamond]\mathbf{a} \oplus \mathbf{b}$

When $\mathbb{O}$ combines with IP3 to give rise to the meaning of IP4, an undesirable inference is generated:

(31)
$$[\![\text{IP4}]\!] = [\diamond](\mathbf{a} \vee \mathbf{b} \vee \mathbf{a} \oplus \mathbf{b}) \wedge \underbrace{[\diamond]\mathbf{a} \rightarrow ([\diamond]\mathbf{b} \vee \diamond\mathbf{a} \oplus \mathbf{b})}_{\neg\mathbb{O}[\diamond]\mathbf{a}} \wedge \underbrace{[\diamond]\mathbf{b} \rightarrow ([\diamond]\mathbf{a} \vee [\diamond]\mathbf{a} \oplus \mathbf{b})}_{\neg\mathbb{O}[\diamond]\mathbf{b}}$$
$$\wedge \underbrace{\underline{[\diamond](\mathbf{a} \vee \mathbf{b}) \rightarrow [\diamond]\mathbf{a} \oplus \mathbf{b}}}_{\neg\mathbb{O}[\diamond](\mathbf{a} \vee \mathbf{b})} \wedge \underbrace{\underline{\neg[\diamond]\mathbf{a} \oplus \mathbf{b}}}_{\neg\mathbb{O}[\diamond]\mathbf{a} \oplus \mathbf{b}}$$

It is undesirable as the combination of the underlined conjuncts, derived from the weakest and the strongest alternative, leads to the following inference, which *contradicts* the assertion:

(32) $\neg[\diamond]\mathbf{a} \oplus \mathbf{b} \wedge ([\diamond](\mathbf{a} \vee \mathbf{b}) \rightarrow [\diamond]\mathbf{a} \oplus \mathbf{b}) = \neg[\diamond]\mathbf{a} \oplus \mathbf{b} \wedge \neg[\diamond](\mathbf{a} \vee \mathbf{b})$

The contradiction can be repaired by adding a numeral classifier to the *wh*-phrase. In other words, replacing the bare *wh*-indefinite in (26) with a non-bare one, as shown in (33), can avoid the undesirable result in (32).

(33) Zilu **keyi**$_D$ kan yi-ben *shenme* shu.
Zilu may read one-CL what book
'Zilu may read some book (I don't care which).'

As exemplified in (24), repeated in (34), the denotation of the *wh*-phrase remains unchanged, denoting a set of books closed under sum formation, and the numeral classifier is a subset selection function, applying to the *wh*-denotation and collecting those members with only one atomic part. The resulting denotation (34c) is the set $\{\mathsf{a}, \mathsf{b}\}$, which is not cumulative. After applying the existential closure operator, the bi-dimensional denotation of the DP containing *one*-CL *what books* is given in (34d) and (34e).

(34) a. $[\![\text{what books}]\!] = \{x \mid \text{books}_{\mathsf{w}}(x)\} = \{\mathsf{a}, \mathsf{b}, \mathsf{a} \oplus \mathsf{b}\}$
b. $[\![\text{one-CL}]\!] = \lambda D\{x \mid x \in D \wedge |\text{ATOM}(x)| = 1\}$
c. $[\![\text{NP}]\!] = \{x \mid x \in [\![\text{what books}]\!] \wedge |\text{ATOM}(x)| = 1\}$
$= \{\mathsf{a}, \mathsf{b}\}$
d. $[\![\text{DP}]\!] = \lambda Q.\lambda w.\exists x[x \in [\![\text{what books}]\!] \wedge |\text{ATOM}(x)| = 1 \wedge Q(x)]$
e. $[\![\text{DP}]\!]^{\text{A}} = \{\lambda Q.\lambda w \exists x[x \in D' \wedge |\text{ATOM}(x)| = 1 \wedge Q_w(x)] : D' \subset [\![\text{what books}]\!]\} \bigcup$
$\{\lambda Q.\lambda w \forall x[x \in [\![\text{what books}]\!] \wedge |\text{ATOM}(x)| = 1 \rightarrow Q_w(x)]\}$

Now, let us consider the derivation of (33), whose LF is represented in (35).

(35) $[_{\text{IP4}} \mathbb{O} [_{\text{IP3}}$ **may** $[_{\text{IP2}}[\text{one-CL what book}]_1 [_{\text{IP1}}$ Zilu$[_{\text{VP}}$ read $t_1]]]]]$

After combining DP pointwise with IP1, we can get a bi-dimensional propositional denotation, as in (36a) and (36b). Adding the deontic possibility modal results in (36c) and (36d).

(36) a. $[\![\text{IP2}]\!] = \mathbf{a} \vee \mathbf{b}$
b. $[\![\text{IP2}]\!]^{\text{A}} = \{\mathbf{a}, \mathbf{b}, \mathbf{a} \wedge \mathbf{b}\}$
c. $[\![\text{IP3}]\!] = [\diamond](\mathbf{a} \vee \mathbf{b})$
d. $[\![\text{IP3}]\!]^{\text{A}} = \{[\diamond]\mathbf{a}, [\diamond]\mathbf{b}, [\diamond](\mathbf{a} \wedge \mathbf{b})\}$

Recursive exhaustification applies to the IP3, generating and then in turn negating the pre-exhaustified alternatives in (37a), finally deriving the inference in (37b).

(37) a. $[\![\text{IP3}]\!]^{\text{Exh-Alt}} = \{\mathbb{O}[\diamond]\mathbf{a}, \mathbb{O}[\diamond]\mathbf{b}, \mathbb{O}[\diamond](\mathbf{a} \wedge \mathbf{b})\}$
b. $[\![\text{IP4}]\!] = \overbrace{[\diamond](\mathbf{a} \vee \mathbf{b})}^{\text{Assertion}} \wedge \overbrace{\underbrace{\neg[\diamond](\mathbf{a} \wedge \mathbf{b})}_{\neg\mathbb{O}[\diamond](\mathbf{a}\wedge\mathbf{b})}}^{\text{Scalar implicature}} \wedge \overbrace{[\diamond]\underbrace{\mathbf{a} \rightarrow [\diamond]\mathbf{b}}_{\neg\mathbb{O}[\diamond]\mathbf{a}} \wedge \underbrace{\diamond\mathbf{b} \rightarrow [\diamond]\mathbf{a}}_{\neg\mathbb{O}[\diamond]\mathbf{b}}}^{\text{MV implicature}}$

(37) does not result in any contradiction. In addition, it encodes total modal variation, namely, that both **a** and **b** are permitted, as long as they are permitted in different worlds.

3.4. Epistemic modals: partial variation

This section is devoted to the account of why epistemic modals are compatible with bare *wh*-indefinites as well as non-bare ones. Let us begin with bare *wh*-indefinites. Consider the following sentence, whose LF is given in (39).

(38) Zilu **keneng**$_E$ kan-le *shenme* shu.
Zilu possibly read-ASP what book
'Zilu possibly read some book(s). (I don't know which).'

(39) $[_{\text{IP4}}\ \mathbb{O}\ [_{\text{IP3}}$ **possibly** $[_{\text{IP2}}\ [_{\text{DP}}\ \exists\ [\text{what books}]]_1\ [_{\text{IP1}}$ Zilu $[_{\text{VP}}$ read $t_1]\ ]\ ]\ ]\ ]$

If we derived the denotation of IP2 in the same way as IP2 in (27), we would get the same contradiction. However, this undesirable result can be avoided if the modal variation property of epistemic modals is taken into consideration. Specifically, as shown in Section 1, epistemic modals require partial modal variation, whose definition is repeated in (40).

(40) Partial (modal) variation: $\exists x \exists y (\diamond\phi(x) \wedge \diamond\phi(y) \wedge x \neq y)$
More than one (but not necessarily all) alternatives in the relevant domain qualify as a possible option.

Therefore, even though we only consider singleton subdomains generated by *wh*-indefinites, as defined in (41), partial modal variation is still achieved.

(41) a. $[\![\exists \text{ [what books]]}]\!]^{\mathrm{DA}^{\mathrm{Sing.}}}$
$= \{\lambda Q.\lambda w.\exists x[x \in D' \wedge Q_w(x)] : D' \subset [\![\text{what books}]\!] \wedge D' \text{ is a singleton set}\}$
b. $[\![\text{what books}]\!] = \{\mathsf{a},\ \mathsf{b},\ \mathsf{a}\oplus\mathsf{b}\}$
c. $\{D'\} = \{\{\mathsf{a}\},\ \{\mathsf{b}\},\ \{\mathsf{a}\oplus\mathsf{b}\}\}$

Since the set $\{\mathsf{a},\mathsf{b}\}$ does not count as a singleton subdomain, it plays no role in the derivation of singleton domain alternatives. As a consequence, no weakest alternative is created, despite the presence of domain cumulativity. The denotations of IP2 and IP3 in (39) can be derived as below ($\diamond$ stands for epistemic possibility modals):

(42) a. $[\![\text{IP2}]\!] = \mathbf{a} \vee \mathbf{b} \vee \mathbf{a} \oplus \mathbf{b}$
b. $[\![\text{IP2}]\!]^{\mathrm{A}} = \{\mathbf{a}, \mathbf{b}, \mathbf{a} \oplus \mathbf{b}\}$
c. $[\![\text{IP3}]\!] = \diamond(\mathbf{a} \vee \mathbf{b} \vee \mathbf{a} \oplus \mathbf{b})$
d. $[\![\text{IP3}]\!]^{\mathrm{A}} = \{\diamond\mathbf{a}, \diamond\mathbf{b}, \diamond\mathbf{a} \oplus \mathbf{b}\}$

Recursive exhaustification makes use of the pre-exhaustified alternatives of IP3, as given in (43a). After affirming the assertion of IP3 and negating all the pre-exhaustified alternatives, the modal variation implicature is derived, i.e., MV implicature in (43b).

(43) a. $[\![\text{IP3}]\!]^{\text{Exh-Alt}} = \{\mathbb{O}\diamond\mathbf{a}, \mathbb{O}\diamond\mathbf{b}\}$

b. $[\![\text{IP4}]\!] = \overbrace{(\diamond(\mathbf{a} \vee \mathbf{b} \vee \mathbf{a} \oplus \mathbf{b})}^{\text{Assertion}} \wedge \overbrace{\neg\diamond(\mathbf{a}\oplus\mathbf{b})}^{\text{Scalar implicature}} \wedge \overbrace{\underbrace{\diamond\mathbf{a} \rightarrow (\diamond\mathbf{b} \vee \diamond\mathbf{a} \oplus \mathbf{b})}_{\neg\mathbb{O}_1\diamond\mathbf{a}} \wedge \underbrace{\diamond\mathbf{b} \rightarrow (\diamond\mathbf{a} \vee \diamond\mathbf{a} \oplus \mathbf{b})}_{\neg\mathbb{O}_1\diamond\mathbf{b}}}^{\text{MV implicature}}$

$= \overbrace{\diamond(\mathbf{a} \vee \mathbf{b} \vee \mathbf{a} \oplus \mathbf{b})}^{\text{Assertion}} \wedge \overbrace{\neg\diamond(\mathbf{a}\oplus\mathbf{b})}^{\text{Scalar implicature}} \wedge \overbrace{\diamond\mathbf{a} \leftrightarrow \diamond\mathbf{b}}^{\text{MV implicature}}$

As a result, we derive a modal variation effect that holds true of **a** and **b**, namely, a subset of the the individuals in the domain. This is essentially how partial modal variation is defined, according to studies like Alonso-Ovalle and Menéndez-Benito (2010), Chierchia (2013) and Fălăus (2014).

Under the scope of epistemic modals, non-bare *wh*-indefinites do not lead to a contradiction, either. Take as an example the following sentence, whose LF structure is represented as (45).

(44) Zilu **keneng**$_E$ kan-le yi-ben *shenme* shu.
Zilu possibly read-ASP one-CL what book
'Zilu possibly read some book. (I don't know which)'

(45) $[_{\text{IP4}}\mathbb{O}[_{\text{IP3}}\ \textbf{possibly}\ [_{\text{IP2}}[\text{one-CL what book}]_1[_{\text{IP1}}\text{Zilu}[_{\text{VP}}\ \text{read}\ t_1]]]]]$

Similar to what we have discussed in the last section, the numeral classifier excludes the maximal individual from the domain given by the *wh*-phrase, as shown by (24) and repeated in (46a). Hence, the denotations of IP2 are derived as (46b) and (46c) (see also (25)).

(46) a. $[\![\text{one-CL what books}]\!] = \{\mathsf{a}, \mathsf{b}\}$
b. $[\![\text{IP2}]\!] = \mathbf{a} \vee \mathbf{b}$
c. $[\![\text{IP2}]\!]^{\text{A}} = \{\mathbf{a}, \mathbf{b}, \mathbf{a} \wedge \mathbf{b}\}$

Adding the epistemic modal results in (47), which is the denotation of IP3. Exhaustification makes use of the denotation of IP3 and the set of pre-exhaustified alternatives in (47b).

(47) a. $[\![\text{IP3}]\!] = \diamond(\mathbf{a} \vee \mathbf{b})$
b. $[\![\text{IP3}]\!]^{\text{Exh-Alt}} = \{\mathbb{O} \diamond \mathbf{a}, \mathbb{O} \diamond \mathbf{b}, \mathbb{O} \diamond (\mathbf{a} \wedge \mathbf{b})\}$

Finally, exhaustification affirms the assertion of IP3 and negates all the pre-exhaustified alternatives not entailed by the assertion, generating the following inference, which is free of contradiction:

(48) $$[\![\text{IP4}]\!] = \overbrace{\diamond(\mathbf{a} \vee \mathbf{b})}^{\text{Assertion}} \wedge \overbrace{\underbrace{\neg \diamond (\mathbf{a} \wedge \mathbf{b})}_{\neg\mathbb{O}\diamond(\mathbf{a}\wedge\mathbf{b})}}^{\text{Scalar implicature}} \wedge \overbrace{\underbrace{\diamond \mathbf{a} \rightarrow \diamond \mathbf{b}}_{\neg\mathbb{O}\diamond\mathbf{a}} \wedge \underbrace{\diamond \mathbf{b} \rightarrow \diamond \mathbf{a}}_{\neg\mathbb{O}\diamond\mathbf{b}}}^{\text{MV implicature}}$$

4. Conclusion

In this study, I have argued that the interaction between modal flavors and the number morphology of existential *wh*-indefinites in Mandarin should be understood along the lines of Alternatives and Exhaustification, as long as nominal references are allowed to play a role in structuring the domain of alternatives. In particular, total modal variation, facilitated by deontic modals, is shown to be only compatible with existential *wh*-indefinites with quantized reference. This is why numeral classifiers are required in existential *wh*-indefinites in a deontic environment. On the other hand, partial modal variation, allowed by epistemic modals, is shown to be compatible with both existential *wh*-indefinites with quantized reference and cumulative reference, hence explaining why numeral classifiers are optional with existential *wh*-indefinites in an epistemic environment.

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Event-related relative measurement[1]

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Abstract. This paper is concerned with relative measurement, which is expressed by percentage nouns and fractions. It has been observed that in some languages a sentence with relative measurement is ambiguous between two readings. I argue that these two readings involve two types of measurement—individual-related measurement and event-related measurement. I also provide a compositional analysis for the ambiguity of relative measurement. My analysis is able to capture many intriguing contrasts between the two readings of relative measurement, including those related to counting recycled individuals, compatibility with verbal affixes, structural distribution and scope.

Keywords: Relative measurement, measure function, event-individual pairs, event semantics

1. Introduction

One of the important properties of natural language is its capacity to express measurement. There are two kinds of measurement: absolute measurement, which is expressed by words such as *liter* and *inch*, and relative measurement, which is expressed by a class of measure items such as proportional nouns like *percent* and fractions like *thirds*. The former type of measurement has received a lot of attention in the semantic literature, while the latter has not until a series of works by Sauerland and Ahn (Sauerland 2014; Ahn and Sauerland 2015a, b, 2017). Unlike absolute measurement, relative measurement concerns the relation between two amounts. For example, in (1), relative measurement is expressed by the relative measure phrase, which consists of the relative measure item *30%* and the nominal phrase *the locals*. This sentence expresses that the local employees at Lenovo made up 30% of all the locals given in the context.

(1) Lenovo hired [30% of the locals].

Beyond the basic pattern, Ahn and Sauerland notice that English has another relative measurement construction, as exemplified in (2). Structurally, this sentence differs from (1) in not having the partitive *of* and the definite determiner, while semantically, it targets a different quantity relation. What this sentence means is that the local employees at Lenovo made up 30% of all the employees at Lenovo. It can be paraphrased as '30% of the people hired by Lenovo were locals.'

(2) Lenovo hired 30% locals.

In some languages, like Mandarin, these two interpretations arise from a single surface structure, as shown in (3).

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(3) Lianxiang gu-le 30% de bendiren
Lenovo hire-ASP 30% DE locals
a. 'Lenovo hired 30% of the locals.' (NP-internal)
$\Rightarrow |\{x : \textbf{locals}(x) \wedge \textbf{Lenovo-hired}(x)\}| = 30\% \times |\{y : \textbf{locals}(y)\}|$
b. 'Lenovo hired 30% locals' (NP-external)
$\Rightarrow |\{x : \textbf{locals}(x) \wedge \textbf{Lenovo-hired}(x)\}| = 30\% \times |\{y : \textbf{Lenovo hired}(y)\}|$

Here, *30% de bendiren* '30% locals' is a noun phrase. In reading (3a), the amount of local employees at Lenovo is measured relative to the set of all locals, which is provided by the NP complement. I call it the 'NP-internal' reading. In reading (3b), the amount of local employees at Lenovo is measured relative to the set of all the people hired by Lenovo, which is provided by the NP-external material, i.e., *Lianxiang gu-le* 'Lenovo hired.' I call it the 'NP-external' reading.

Intuitively, the NP-internal reading in (3a) expresses a quantity relation between two sets of locals—the set of locals hired by Lenovo and the set of all locals; whereas the NP-external reading in (3b) expresses a quantity relation between two sets of event participants—the set of theme participants of some hiring events who are locals and the set of all theme participants of some hiring events. Following this intuition, I argue that the NP-internal reading differs from the NP-external reading essentially in their domains of measurement: the former involves measurement of individuals, while the latter involves measurement of event-individual pairs, whose ontological status is considered to be stages of individuals (Barker 1999, 2010). (For example, if John dances twice, he participates in two non-overlapping dancing events e_1 and e_2. The event-individual pairs $\langle e_1, \textbf{John}\rangle$ and $\langle e_2, \textbf{John}\rangle$ stand for two stages of John).

This claim is based on the observation that although the two readings seem to measure individuals, only the NP-external reading shows event-related properties (Section 2). I propose that there are two kinds of relative measure heads: one implements measurement on a domain of individuals, while another encodes measurement on a domain of event-individual pairs. These two relative measure heads essentially give rise to the NP-internal reading and the NP-external reading (Section 3). I also show that these two readings can be compositionally derived (Section 3.2). My analysis is able to account for a series of contrasts between the NP-internal reading and the NP-external reading, which involve a structural constraint on the NP-external reading (Section 4), the monotonicity condition of measure functions (Section 5) and scope patterns of relative measure phrases (Section 6). Finally, I compare my analysis with the focus mapping approach to relative measurement proposed by Ahn and Sauerland (Sauerland 2014; Ahn and Sauerland 2015a, b) (Section 7).

2. Counting recycled individuals

Let's consider the following scenario. Town A has a population of 10,000, among which 2,000 are children. In the past quarter, a clinic in the town had 5,000 visits by 2,000 different patients. Among the 5,000 visits there were 1,500 visits by 500 different children. In the quarterly business meeting, if the administrator of the clinic states (4), the statement is inaccurate. Instead, if she states (5), the statement is accurate.

(4) Women zhe yi jidu shouzhi-le quanzheng 30% de ertong.
we this one quarter treat-ASP whole.town 30% DE children
'We treated 30% of the children in the town this quarter.' (NP-internal)

(5) Women zhe yi jidu shouzhi-le 30% de ertong.
we this one quarter treat-ASP 30% DE children
a. 'We treated 30% of the children (in the town) this quarter.' (NP-internal)
b. 'We treated 30% children this quarter.' (NP-external)

Due to the explicit mentioning of the town, which helps to fix the domain of the children, (4) only has an NP-internal reading. It is clear why (4) is false: the number of children treated in the clinic is 500 but the total child population in the town is 2,000, so 30% is not an accurate proportion to report.

(5) is ambiguous between an NP-internal reading and an NP-external reading. As we know that the NP-internal reading is false, the truth judgment must come from the NP-external reading. However, only under a specific circumstance may the NP-external reading give rise to a true statement—a single individual can be counted more than once if she makes more than one visit. To see this, note that if we merely count the number of child patients (i.e., 500) relative to the number of total patients (i.e., 2,000), we get 25% instead of 30%. However, if we count the number of child visits (i.e., 1,500) relative to the number of total visits (i.e., 5,000), we get 30%. In short, the truth of (5) tells us that the NP-external reading allows counting recycled individuals.

The possibility of counting recycled individuals should remind us of Krifka's (1990) famous example in (6). This sentence is argued to have two interpretations. The first one is an object-related interpretation and the second one is an event-related interpretation, as paraphrased in (6a) and (6b), respectively. If a certain ship passed through the lock twice, it is counted once in the first reading and twice in the second reading.

(6) Four thousand ships passed through the lock last night.
a. There were 4000 ships such that they passed through the lock. (Object-related)
b. There were 4000 events such that in each of them a ship passed through the lock. (Event-related)

Since Krifka (1990), various proposals have been defended to account for the ambiguity of (6), such as Moore (1994), Doetjes and Honcoop (1997) and Barker (1999). These proposals share the core idea that recycled individuals are counted by relation to events. The fact that the NP-external reading allows the counting of recycled individuals suggests that this reading should, too, be event-related.

To see that counting recycled individuals is indeed readily compatible with the NP-external reading of relative measurement and hence is not an artifact of Scenario 1, it is worthwhile to consider more examples:

(7) Women jiudian qunian jiedai-le 30% de gaoguan.
we hotel last.year serve-ASP 30% DE high-ranking.officials
a. 'Last year, our hotel served 30% of the high-ranking officials. (NP-internal)
b. 'Last year, our hotel served 30% high-ranking officials.' (NP-external)

(8) Women tushuguan qunian jiechu-le 70% de xiaoshuo.
we library last.year lend.out-ASP 70% DE novel
a. 'Last year, our library lent out 70% of the novels.' (NP-internal)
b. 'Last year, our library lent out 70% novels.' (NP-external)

In these sentences, the identities of the individuals being talked about are irrelevant and easy to ignore in the NP-external reading. In (7), if some high-ranking officials stayed in our hotel twice, each of them could only be counted once in the NP-internal reading, but each of them was counted twice in the NP-external reading. In (8), the same contrast can be observed between the NP-internal reading and the NP-external reading, if some novels were lent out more than once.

3. Proposal

In this paper, I propose that relative measurement generally measures the size of one set relative to another, but the members of the sets can be **individual objects** or **event-related stages** of individuals. Measuring individuals yields the NP-internal reading, while measuring event-related stages results in the NP-external reading. Ontologically, an event-related stage can be understood as an instance of an individual object that participates in a specific event (see also Barker 1999, 2010). Following Barker (1999), I model event-related stages as event-individual pairs $\langle e, x\rangle$ associating an individual x with an event e. As a first approximation, the two readings of (9) can be represented as (9a) and (9b).

(9) Lianxiang gu-le 30% de bendiren.
Lenovo hire-ASP 30% DE local
a. NP-internal: $|\{x : \mathbf{locals}(x) \wedge \mathbf{Lenovo\text{-}hired}(x)\}| = 30\% \times |\{y : \mathbf{locals}(y)\}|$
(The individuals x such that x are locals and hired by Lenovo made up 30% of the locals)
b. NP-external: $|\{\langle e, x\rangle : \mathbf{locals}(x) \wedge \mathbf{Lenovo\text{-}hired}(e, x)\}|$
$= 30\% \times |\{\langle e', x'\rangle : \mathbf{Lenovo\text{-}hired}(e', x')\}|$
(The event-related stages $\langle e, x\rangle$ such that x are locals and were hired by Lenovo in e made up 30% of the event-related stages $\langle e', x'\rangle$ such that x' were hired by Lenovo in e')

In the following subsections, I lay out the formal details of my proposal, showing how the two readings are compositionally derived.

3.1. Two relative measure heads

I propose that a relative measure item is decomposed into two parts—a percentage number and a relative measure head (RM). The former simply denotes a number of type d and the latter encodes measurement, which can be individual-related or event-related. I define the individual-related RM (RM_I) and the event-related RM (RM_E) as follows:

(10) $$[\![\text{RM}_I]\!] = \lambda n_{\mathsf{d}} \lambda P_{\mathsf{et}} \lambda Q_{\mathsf{et}}.\exists x.P(x) \wedge Q(x) \wedge \mathbf{card}(x) = n \times \mathbf{max}\left(\lambda n' \exists x' \begin{bmatrix} P(x') \wedge \\ \mathbf{card}(x') = n' \end{bmatrix}\right)$$

(11) $$[\![\text{RM}_E]\!] = \lambda n''_{\mathsf{d}} \lambda P_{\mathsf{et}} \lambda T_{\langle \mathsf{e},\langle \mathsf{e},\mathsf{vt}\rangle\rangle} \lambda y_{\mathsf{e}} \lambda e''_{\mathsf{v}}.\mathbf{MXT}(e'') \wedge \exists \langle e,x\rangle.e \sqsubseteq e'' \wedge T(e,y,x) \wedge P(x) \wedge \mathbf{card}'_{\lambda z \lambda e'''.T(e''',y,z)}(e,x) = n \times \mathbf{max}\left(\lambda n' \exists \langle e',x'\rangle \begin{bmatrix} e' \sqsubseteq e'' \wedge R(e',y,x') \wedge \\ \mathbf{card}'_{\lambda z \lambda e'''.T(e''',y,z)}(e',x') = n' \end{bmatrix}\right)$$

A note on notation: **max** and **MXT** stand for a maximal operator on degrees and a maximal operator on events, respectively. The former takes a set of degrees and returns the biggest element in this set, while the latter applies to maximal events consisting of the sum of all smaller events within a given time interval. They are defined as follows:

(12) a. $\mathbf{max}(D) := \iota n[D(n) \wedge \forall n'[D(n') \rightarrow n' \leq n]]$
b. $\mathbf{MXT}(e) := \exists t.e = \bigoplus(\lambda e'[\tau(e') \sqsubseteq t])$ (Krifka 1989)

In (10), RM_I introduces a measure function **card** (cardinality) on the domain of individuals. In this paper, I use the term *measure function* to denote a mapping from a class of entities to a degree scale that preserves an ordering relation, such as "be taller than" or "be heavier than." Examples of typical measure functions are height, weight, and temperature. Following Krifka (1998), we define **card** as a function mapping individual entities to natural numbers.

In (11), RM_E introduces a measure function $\mathbf{card}'$ on the domain of event-individual pairs. In this study, I follow Doetjes and Honcoop's (1997) definition of measure functions on event-individual pairs. Adopting the algebraic semantic approach (Krifka 1989, 1990), Doetjes and Honcoop identify the domain of event-individual pairs as a join semi-lattice on the basis of the join semi-lattice structure of the domain of events. Then, the partial ordering on ordered event-individual pairs can be defined as (13) in terms of the partial ordering of events and the partial ordering of individuals.

(13) a. $\langle e,x\rangle \sqsubseteq \langle e',x'\rangle \leftrightarrow \langle e,x\rangle \oplus \langle e',x'\rangle = \langle e',x'\rangle$
b. $\langle e,x\rangle \oplus \langle e',x'\rangle = \langle e'',x''\rangle \leftrightarrow e \oplus e' = e'' \wedge x \oplus x' = x''$

Based on this algebraic structure, they implement Krifka's (1990) proposal on the measurement of events. The main idea that their implementation relies on is that the measure function $\mathbf{card}'$ on event-individual pairs can be standardized with respect to its corresponding measure function **card** on individuals. Take children-treating events as an example. If every child is treated once, measuring the $\langle e,x\rangle$ pairs such that x is a child and x is treated in e yields the same value as measuring children that are treated. In this case, different children are involved in different events. As a consequence, if there are n different children, there are the same number of pairs of treating events and children.

However, there is a problem: if some children were treated more than once, the equivalence of the pair measurement and the object measurement does not hold. In this case, the relation on treating children has the aspectual property of iterativity as defined below (Krifka 1989; Doetjes and Honcoop 1997):

(14) **Definition** (Iterativity (**ITER**)) For any event e, object x and relation R,
$\mathbf{ITER}(e,x,R) \leftrightarrow R(e,x) \wedge \exists e' \exists e'' \exists x'[e' \sqsubseteq e \wedge e'' \sqsubseteq e \wedge e' \neq e'' \wedge x' \sqsubseteq x \wedge R(e',x') \wedge R(e'',x')]$
(a relation R is iterative with respect to an event e and an object x just in case there is a part of x which is involved in different parts of e, as specified by R)

It does not mean that standardizing one measure function with respect to another cannot work in this case. On the basis of the fact that every iterative event can be partitioned into non-iterative subevents, Krifka (1990) proposes that an iterative event e can be correctly counted by dividing e into non-iterative subevents, applying a measure function on events to each non-iterative subevent, and adding all the values of the non-iterative subevents together. Following the spirit of this proposal, Doetjes and Honcoop define a measure function on $\langle e,x\rangle$ in terms of its corresponding measure function on objects. Based on their study, I define the measure function on event-individual pairs as (15).

(15) Let μ be a measure function and R be an event-individual relation. Then the object induced event-individual pair measure function μ'_R can be defined as follows:
$\mu'_R =$ the event-individual pair measure function μ' with the smallest domain such that
a. **Standardization** For any event e, individual x and relation R,
$[\neg\mathbf{ITER}(e,x,R) \wedge R(e,x)] \rightarrow [\mu'(e,x) = n \leftrightarrow \mu(x) = n]$
b. **Generalization** For any events e and e', and any individuals x and x',
$[\neg\langle e,x\rangle \circ \langle e',x'\rangle \wedge \mu'(e,x) = n \wedge \mu'(e',x') = n'] \rightarrow [\mu'(\langle e,x\rangle \oplus \langle e',x'\rangle) = n+n']$
Here, $\circ$ stands for 'overlapping' and $\langle e,x\rangle \circ \langle e',x'\rangle \leftrightarrow e \circ e' \wedge x \circ x'$

Consider a toy scenario. Three children C_1, C_2 and C_3 are involved in three treating events e_1, e_2 and e_3, respectively. Additionally, C_1 is treated a second time, so it is also involved in a fourth treating event e_4. Therefore, the pair $\langle e_1 \oplus e_2 \oplus e_3 \oplus e_4,\ C_1 \oplus C_2 \oplus C_3\rangle$ is in the relation of children-treating. Standardization can partition the pair into two parts $\langle e_1 \oplus e_2 \oplus e_3,\ C_1 \oplus C_2 \oplus C_3\rangle$ and $\langle e_4, C_1\rangle$. Then, the measure function μ' yields the value 3 for $\langle e_1 \oplus e_2 \oplus e_3,\ C_1 \oplus C_2 \oplus C_3\rangle$, and the value 1 for $\langle e_4, C_1\rangle$. Generalization adds up the two values to 4. The result is as if C_1 is counted twice. Thus, μ' provides an explicit way to count recycled individuals described in Section 2.

3.2. Composition

Recall example (3) in the first section, repeated here as (16). According to the proposal discussed in the previous section, the relative measure item *30%* consists of a percentage number and a null relative measure head, which can be RM_I or RM_E.

(16) Lianxiang gu-le 30% de bendiren
Lenovo hire-ASP 30% DE locals
a. 'Lenovo hired 30% of the locals.' (NP-internal)
b. 'Lenovo hired 30% locals.' (NP-external)

I define the relevant lexical entries in the following table:

Item	Translation	Type
Lianxiang 'Lenovo'	**Lenovo**	e
30%	30%	d
bendiren 'locals'	$\lambda x.{*}\mathbf{local}(x)$	et
de	$\lambda x.x$	$\langle \alpha, \alpha \rangle$
EC	$\lambda V \exists e.V(e)$	$\langle \text{vt,t} \rangle$
gu 'hire'	$\lambda x \lambda y \lambda e.{*}\mathbf{hire}(e) \wedge {*}\mathbf{th}(e) = x \wedge {*}\mathbf{ag}(e) = y$	$\langle \text{e}, \langle \text{e, vt} \rangle \rangle$
RM_I	see (10)	$\langle \text{d}, \langle \text{et}, \langle \text{et,t} \rangle \rangle \rangle$
RM_E	see (11)	$\langle \text{d}, \langle \text{et}, \langle \langle \text{e}, \langle \text{e,vt} \rangle \rangle, \langle \text{e,vt} \rangle \rangle \rangle \rangle$

In event semantics, a transitive verb is assumed to have three arguments—two individual arguments and one event argument (Krifka 1998; Landman 2000). The individual arguments serve as the agent (**ag**) and the theme (**th**) of the event. The event argument is bound by an existential closure operator (EC) at the sentential level. Additionally, I assume that not only plural nouns but also event predicates and thematic roles are closed under sum, which is indicated by the *-operator (Landman 2000; Kratzer 2007; Champollion 2010).

In Mandarin, the particle *de* is often used as a modification marker, but it can also be used in measurement constructions, as in (17). Its status is not clear in these measurement constructions (Cheng and Sybesma 2009; Li and Rothstein 2012; a.o.). In this paper, I simply assume that the particle *de* is a type-neutral identity function, which passes up the meaning of a constituent that combines with it.

(17) san-bang de rou / suoyou de xuesheng
three-pound DE meat / all DE student
'three pounds of meat' / 'all of the students'

Let's consider the NP-external reading first. The object relative measure phrase is composed via Functional Application (FA), as illustrated in (18).

(18) $[\![de]\!]([\![\mathrm{RM}_E]\!]([\![30\%]\!]))([\![\text{locals}]\!]) \overset{\mathsf{FA}}{\Rightarrow}$

$$\lambda T \lambda y \lambda e''.\mathbf{MXT}(e'') \wedge \exists\langle e,x\rangle.e \sqsubseteq e'' \wedge T(e,y,x) \wedge {}^*\mathbf{local}(x) \wedge \mathbf{card}'_{\lambda z\lambda e'''.T(e''',y,z)}(e,x) = 30\% \times \mathbf{max}\left(\lambda n' \exists\langle e',x'\rangle \begin{bmatrix} e' \sqsubseteq e'' \wedge R(e',y,x') \wedge \\ \mathbf{card}'_{\lambda z\lambda e'''.T(e''',y,z)}(e',x') = n' \end{bmatrix}\right)$$

As a result, the relative measure phrase denotes a function of type $\langle\langle \mathsf{e},\langle \mathsf{e,vt}\rangle\rangle,\langle \mathsf{e,vt}\rangle\rangle$. It maps the set characterized by a transitive verb, i.e., a set of $\langle e,y,x\rangle$ sequences, to the set characterized by a verb phrase, i.e., a set of $\langle e,y\rangle$ sequences.

(19) a. $[\![30\%\ \mathrm{RM}_E\ \textit{de}\ \text{locals}]\!]([\![\text{hire}]\!]) \overset{\mathsf{FA}}{\Rightarrow}$

$$\lambda y \lambda e''.\mathbf{MXT}(e'') \wedge \exists\langle e,x\rangle.e \sqsubseteq e'' \wedge [\![\text{hire}]\!](e,y,x) \wedge {}^*\mathbf{local}(x) \wedge \mathbf{card}'_{\lambda z\lambda e'''.[\![\text{hire}]\!](e''',y,z)}(e,x) = 30\% \times \mathbf{max}\left(\lambda n' \exists\langle e',x'\rangle \begin{bmatrix} e' \sqsubseteq e'' \wedge [\![\text{hire}]\!](e',y,x') \wedge \\ \mathbf{card}'_{\lambda z\lambda e'''.[\![\text{hire}]\!](e''',y,z)}(e',x') = n' \end{bmatrix}\right)$$

b. $[\![\text{EC}]\!]([\![\text{hire } 30\%\ \mathrm{RM}_E\ \textit{de}\ \text{locals}]\!]([\![\text{Lenovo}]\!])) \overset{\mathsf{FA}}{\Rightarrow}$

$$\exists e''.\mathbf{MXT}(e'') \wedge \exists\langle e,x\rangle.e \sqsubseteq e'' \wedge [\![\text{hire}]\!](e,\mathbf{l},x) \wedge {}^*\mathbf{local}(x) \wedge \mathbf{card}'_{\lambda z\lambda e'''.[\![\text{hire}]\!](e''',\mathbf{l},z)}(e,x) = 30\% \times \mathbf{max}\left(\lambda n' \exists\langle e',x'\rangle \begin{bmatrix} e' \sqsubseteq e'' \wedge [\![\text{hire}]\!](e',\mathbf{l},x') \wedge \\ \mathbf{card}'_{\lambda z\lambda e'''.[\![\text{hire}]\!](e''',\mathbf{l},z)}(e',x') = n' \end{bmatrix}\right)$$

(19b) says: there is a maximal event within a specific time interval; the maximal event contains hiring subevents whose agents are Lenovo and whose themes are locals; the measure function $\mathbf{card}'_{\lambda z\lambda e'''.[\![\text{hire}]\!](e''',\mathbf{l},z)}$ applies to the theme participants of these events, which are stages of individuals participating in these hiring events. The result is equal to 30% times the maximal number of the theme participants of the events of Lenovo's hiring.

Turning to the NP-internal reading, the object relative measure phrase in (16) denotes a generalized quantifier of type $\langle \mathsf{et,t}\rangle$, as illustrated by the following compositional process.

(20) $[\![de]\!]([\![\mathrm{RM}_I]\!]([\![30\%]\!]))([\![\text{locals}]\!]) \overset{\mathsf{FA}}{\Rightarrow}$

$$\lambda Q \exists x.{}^*\mathbf{local}(x) \wedge Q(x) \wedge \mathbf{card}(x) = 30\% \times \mathbf{max}\left(\lambda n' \exists x' \begin{bmatrix} {}^*\mathbf{local}(x') \wedge \\ \mathbf{card}(x') = n' \end{bmatrix}\right)$$

Hence, we can compose the relative measure phrase with the rest of the sentence by Quantifier Raising, as shown in (21).

(21) $[\![30\%\ \text{RM}_I\ de\ \text{locals}]\!](\lambda x.[\![[\text{EC [Lenovo hire } t_1]]]\!]^{g[1/x]}) \overset{\text{FA}}{\Rightarrow}$
$$\exists x \exists e.{*}\mathbf{local}(x)\ \wedge [\![\text{hire}]\!](e,\mathbf{l},x) \wedge \mathbf{card}(x) = 30\% \times \mathbf{max}\left(\lambda n' \exists x' \begin{bmatrix} {*}\mathbf{local}(x') \wedge \\ \mathbf{card}(x') = n' \end{bmatrix}\right)$$

(21) says: there are locals hired by Lenovo; the measure function $\mathbf{card}(x)$ applies to them and the result is equal to 30% times the maximal number of locals.

According to my proposal, the NP-external reading involves the measure function on event-individual pairs. As we have presented in Section 3.1, the measure function counts recycled individuals more than once. By contrast, the NP-internal reading involves the measure function on individuals. Therefore, when an individual participates in an event twice, it can only be counted once. This is the reason for the contrast between the NP-internal reading and the NP-external reading on counting recycled individuals.

In addition to counting recycled individuals, the current analysis can account for more contrasts between the NP-internal reading and the NP-external reading, which are listed below:

- The NP-external reading is only available when a relative measure phrase occupies the object position, but the NP-internal reading is not subject to this constraint;
- When a relative measure phrase has a NP-external reading, the Monotonicity Condition constrains measure functions on event-related domains, whereas when a relative measure phrase has a NP-internal reading, the Monotonicity Condition constrains the individual domain.
- A relative measure phrase with a NP-external reading shows weak island sensitivity. For example, it cannot scope over negation or universal quantifiers. However, a relative measure phrase with a NP-internal reading does not have this property.

The following sections discuss these contrasts and demonstrate how the current analysis captures them.

4. A structural constraint

The first intriguing contrast between the NP-external reading and the NP-internal reading is a structural constraint. Specifically, the NP-external reading may only be observed when a relative measure phrase is used as the object of a transitive verb, but the NP-internal reading is not subject to the same constraint. As shown in (22), a relative measure phrase in the subject position does not give rise to the NP-external reading.

(22) 30% de kuaguo gongsi gu-le bendiren.
30% DE international company hire-ASP locals
a. '30% of the international companies hired locals.' (NP-internal)
b. #'30% of the units that hired locals were international companies.' (NP-external)

According to my analysis, a relative measure phrase with a NP-external reading has the type $\langle\langle e,\langle e,vt\rangle\rangle,\langle e,vt\rangle\rangle$. Following Krifka (1989) and Landman (2000), I assume that the agent and the theme are syntactic arguments of a transitive verb, i.e., a transitive verb has the type $\langle e,\langle e,vt\rangle\rangle$. Consequently, a relative measure phrase with a NP-external reading must combine with a transitive verb, instead of an element of type $\langle e,vt\rangle$, such as an intransitive verb or a verb phrase. Structurally speaking, therefore, the NP-external reading should only be observed when a relative measure phrase is used as the object of a transitive verb.

The same contrast is observed between objects and PP complements, as exemplified by the following examples.

(23) Zhengfu [$_{PP}$ gei bendiren] fenpei-le 50% de gongwu.
government to locals assign-ASP 50% DE public.housing
a. 'The government assigned 50% of the public housing to locals.' (NP-internal)
b. '50% of the housing that government assigned to locals is public housing.' (NP-external)

(24) Zhengfu [$_{PP}$ gei 50% de bendiren] fenpei-le gongwu.
government to 50% DE locals assign-ASP public.housing
a. 'The government assigned public housing to 50% of the locals.' (NP-internal)
b. #'50% of the people that the government assigned public housing to are locals.' (NP-external)

Generally, a preposition is a function taking an individual element of type e and returning a verb phrase modifier of type $\langle\langle e,vt\rangle,\langle e,vt\rangle\rangle$. We may reason that its type is $\langle e,\langle\langle e,vt\rangle,\langle e,vt\rangle\rangle\rangle$. Given this type, a relative measure phrase with the NP-external reading cannot combine with a preposition.

It should be noted that the type $\langle\langle e,\langle e,vt\rangle\rangle,\langle e,vt\rangle\rangle$ is not specific to relative measure phrases. In Mandarin, many event-related modifiers share the same type. For example, it has been a long-standing puzzle that temporal and spatial measure phrases are often used as NP-internal modifiers (Huang 1992), as shown below:

(25) Libai chi-le yi-ge xiaoshi de pingguo.
Libai eat-ASP one-CL hour DE apple
'Libai ate apples for an hour.'

(26) Libai kai-le yibai gongli de che.
Libai drive-ASP one.hundred km DE car
'Libai drove for 100 km.'

There is no doubt that *yi-ge xiaoshi* 'one hour' and *yibai gongli* '100 km' in these examples measure the temporal duration of the apple-eating event and the distance of the driving event, respectively. Their English counterparts are in the form of *for*-adverbials, but they syntactically look like nominal modifiers.

The current proposal on relative measure items with the NP-external reading can be extended to these event-related NP-internal elements. Specifically, they all involve event-related measurement and have a uniform semantic type—$\langle \mathsf{et}, \langle \langle \mathsf{e}, \langle \mathsf{e,vt} \rangle \rangle, \langle \mathsf{e,vt} \rangle \rangle \rangle$. It means that all the NP-internal elements take as arguments an individual predicate and an event-individual relation. The latter enables them to exhibit event-related interpretations. Based on previous studies on temporal and space measure phrases (Moltmann 1991; Krifka 1998; Zwarts 2005; Champollion 2010; a.o.), I suggest the following lexical entries for *yi-ge xiaoshi* 'one hour' and *yibai gongli* '100 km.'

(27) $[\![\text{one hour}]\!] = \lambda P_{\mathsf{et}} \lambda R_{\langle \mathsf{e}, \langle \mathsf{e,vt} \rangle \rangle} \lambda y \lambda e \exists x.P(x) \wedge R(e,y,x) \wedge \mathbf{hour}'(e) = 1$

(28) $[\![\text{100 km}]\!] = \lambda P_{\mathsf{et}} \lambda R_{\langle \mathsf{e}, \langle \mathsf{e,vt} \rangle \rangle} \lambda y \lambda e \exists x.P(x) \wedge R(e,y,x) \wedge \mathbf{km}'(e) = 100$

Similar to relative measure items with an external reading, both *one hour* and *100 km* introduce an event-related measure function, i.e., $\mathbf{hour}'$ and $\mathbf{km}'$. The former is standardized for events by requiring that $\mathbf{hour}'(e) = \mathbf{hour}(\tau(e))$, in which the trace function τ maps an event to its running time. The latter must apply to motion events denoted by movement predicates like *walk* and *drive*. The measure function $\mathbf{km}'$ is standardized for movement events by defining that $\mathbf{km}'(e) = \mathbf{km}(\sigma(e))$, in which the trace function σ maps a motion event to the path that the event is linked to.

After combining these NP-internal modifiers with the NP complement, the object phrases in (25) and (26) have the same type as the relative measure phrases with the NP-external reading, i.e., $\langle \langle \mathsf{e}, \langle \mathsf{e,vt} \rangle \rangle, \langle \mathsf{e,vt} \rangle \rangle$. It is predicted that these object phrases cannot be dislocated as topics. This is borne out, as in (29). In these examples, IP should have the type $\langle \mathsf{e,vt} \rangle$, and hence cannot combine with the topic phrases.

(29) a. *Yi-ge xiaoshi de pingguo, [$_{\mathsf{IP}}$ Libai chi-le].
one-CL hour DE apple Libai eat-ASP
'Libai ate apples for a hour.'
b. *Yibai gongli de che, [$_{\mathsf{IP}}$ Libai kai-le].
one.hundred km DE car Libai drive-ASP
'Libai drove for 100 km.'

In addition, these event-related lexical items are not the only ones that can claim the type $\langle \langle \mathsf{e}, \langle \mathsf{e,vt} \rangle \rangle, \langle \mathsf{e,vt} \rangle \rangle$. Working in an event-free semantics, Szabolcsi (1989, 1992, 2014) essentially suggests that reflexives and bound pronouns also have the same type (minus the event arguement). In Keenan's (2016) theory, quantifiers can be regarded as arity-reducers. They apply to an n-place function and return an $(n-1)$-place function, and they do so in all their grammatical occurrences. On this view, a relative measure phrase of type $\langle \langle \mathsf{e}, \langle \mathsf{e,vt} \rangle \rangle, \langle \mathsf{e,vt} \rangle \rangle$ is considered a quantifier that applies to a three-place function of type $\langle \mathsf{e}, \langle \mathsf{e,vt} \rangle \rangle$ and returns a two-place function of type $\langle \mathsf{e,vt} \rangle$.

5. Event maximalization suffixes

Mandarin has some verbal suffixes serving to assert that the events denoted by a verb are realized to the maximal degree. Examples of these suffixes include *wan* and *guang*, which are understood as 'completely,' 'entirely' or 'fully' in English. Consider the following sentences with such a suffix:

(30) Libai chi-wan/guang-le ershi-ke shuijiao.
Libai eat-WAN/GUANG-ASP twenty-CL dumpling
'Libai completely ate twenty dumplings.'

(31) Libai chi-wan/guang-le shuijiao.
Libai eat-WAN/GUANG-ASP dumpling
'Libai completely ate the dumplings.'

The uses of *wan/guang* in (31) and (30) are to assert that Libai's eating of dumplings is realized to the maximal degree (see also Filip 2008). (30) says that twenty dumplings were eaten and none of them was left. In (31), the bare noun *shuijiao* 'dumplings' must be understood as a definite noun and refer to the unique and maximal set of dumplings in a given context. The sentence is true if and only if Libai ate all of the dumplings in some time interval. In this paper, I call these suffixes 'event maximalization suffixes' (EMS).

Interestingly, the occurrence of an EMS blocks the NP-external reading of a relative measure phrase. Consider (32), in which only the NP-internal reading is available. As a minimal pair to this sentence, (33) shows that the NP-external reading returns when the EMS is removed.

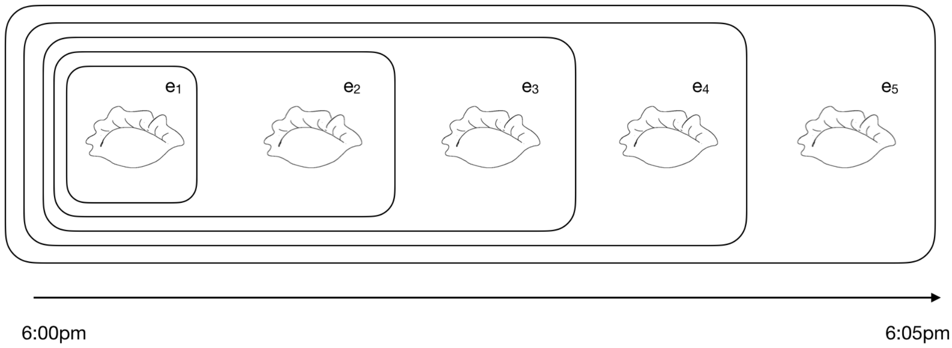
(32) Libai chi-wan/guang-le yi-duo-ban de shuijiao.
Libai eat-WAN/GUANG-ASP one-more-half DE dumplings
a. NP-internal: 'Libai completely ate more than half of the dumplings.'
b. #NP-external: 'More than half of the food that Libai completely ate were dumplings.'

(33) Libai chi-le yi-duo-ban de shuijiao.
Libai eat-ASP one-more-half DE dumplings
a. NP-internal: 'Libai ate more than half of the dumplings.'
b. NP-external: 'More than half of the food that Libai ate were dumplings.'

This contrast would be mysterious if the NP-external reading and the NP-internal reading both involved measurement of individuals. However, if the NP-external reading involves measurement in an event-related domain, its disappearance in (32) is expected. The unavailability of the NP-external reading is due to the requirement of EMSs that event predicates they combine with must be telic.

To my knowledge, there have not been formal studies on this kind of verbal suffixes in Mandarin. Both Moltmann (1997) and Piñón (2005) propose formal analyses for English adverbial *completely*, which can be seen as the semantic counterpart of EMSs. While it is not impossible to formalize EMSs using ingredients from these approaches to fit in the current picture, doing so adds substantial complexity to the compositional semantics developed so far and would take us too far afield. In this section, I just illustrate the function of EMSs with the help of the picture in (34).

(34) The events of eating dumplings



This picture demonstrates a set of partially ordered events, i.e., the events of eating dumplings. This set is ordered relative to the cardinality of the dumplings being consumed in the context (see Krifka 1989, 1998, Kennedy 2012). All the five events are in the set denoted by the verb phrase *chi shuijiao* 'eat dumplings,' but only e_5, in which all the dumplings were eaten, is in the set denoted by the verb phrase *chi-wan shuijiao* 'completely eat the dumplings.' In short, the verb phrase with an EMS denotes an event in which its theme participant must be the sum of all the things affected by the event in some time interval.

Consequently, the domain denoted by the verb phrase with an EMS has a trivial part-whole structure. As illustrated in the figure, only e_5 is in the domain of *chi-wan shuijiao* 'completely eat the dumplings.' None of its proper subparts belongs to the same domain. In slightly more formal terms, this means that a verb phrase with an EMS is quantized, and hence, according to Krifka (1989, 1998), telic. (35) shows that such a verb phrase is incompatible with an NP-internal temporal measure phrase, which is the counterpart of English *for*-adverbials (see Section 4). By contrast, a verb phrase with an EMS is compatible with (and in fact required by) an *in*-adverbial, as shown in (36) (see also Xuan 2010).

(35) Libai chi-(*wan/guang)-le yi-ge xiaoshi de shuijiao.
Libai eat-WAN/GUANG-ASP one-CL hour DE dumpling
'Libai (*completely) ate (*the) dumplings for one hour.'

(36) Libai yi ge xiaoshi zhilei jiu chi-*(wan/guang)-le shuijiao.
Libai one CL hour within just eat-WAN/GUANG-ASP dumpling
'Libai *(completely) ate *(the) dumplings in one hour.'

According to the literature (Dowty 1979; Krifka 1998; Rothstein 2004; a.o.), a telic predicate can be modified by *in*-adverbials but resists *for*-adverbials. The (in)compatibility of a verb phrase with an EMS is hence a telltale sign about the event structure of the VP denotation.

Returning to relative measurement, the NP-external reading of (32) is blocked by the EMS because event-related measurement is not compatible with telic predicates. In this example, the event domain is characterized by the incremental verb with an EMS, i.e., *chi-wan*. As described before, a verb suffixed by an EMS denotes an event whose theme is maximal with respect to a time interval, and hence it and its sub-parts do not belong to the same domain. In other words, the domain characterized by *chi-wan* has a trivial part-whole structure. Applying a measure function on this domain leads to violation of a general constraint, namely, that the domain must have a non-trivial part-whole structure. This constraint has been repeatedly verified in various measurement constructions, such as pseudopartitives (Schwarzschild 2002, 2006; Champollion 2017), comparatives (Wellwood 2015) and Japanese split measure phrase constructions (Nakanishi 2007).

6. Scope and weak islands

Doetjes and Honcoop (1997) argue that quantification over event-individual pairs is sensitive to weak islands in the sense of Szabolcsi and Zwarts (1992). Specifically, event-related interpretations are not available if quantification over event-individual pairs scopes over negation or universal quantifiers. The same pattern is also observed for the NP-external reading of relative measurement.

The NP-external reading and the NP-internal reading of relative measurement show a contrast with respect to scope-taking. When a relative measure phrase has a NP-internal reading, it can take wide or narrow scope relative to negation, as illustrated in (37).

(37) Lianxiang **meiyou** gu 70% de bendiren.
Lenovo not hire 70% DE locals
a. 'It is not the case that Lenovo hired 70% of the locals.' (*not* $>$ 70%$_{\text{internal}}$)
b. '70% of the locals were such that Lenovo didn't hire them.' (70%$_{\text{internal}}$ $>$ *not*)

By contrast, if a relative measure phrase has a NP-external reading, it cannot take wide scope over negation, as shown in (38).

(38) Lianxiang **meiyou** gu 70% de bendiren.
Lenovo not hire 70% DE locals
a. 'It is not the case that 70% of the people hired by Lenovo were locals.' (*not* $>$ 70%$_{\text{external}}$)
b. #'70% of the people that Lenovo didn't hire were locals.' (70%$_{\text{external}}$ $>$ *not*)

Similar to negation, universal quantification has to take scope over relative measure phrases in order to preserve the NP-external reading, as exemplified by the following example.

(39) Mei nian cha shui de shihou, zhengfu dou hui shencha 20% de
every year review tax DE time government DOU will audit 20% DE
kuaguo gongsi.
international company
a. ‘Every tax year, 20% of the organizations that the government audits are international companies.’ (*every* $>$ 20%$_{\text{external}}$)
b. #‘20% of the units that the government audits every tax year are international companies.’ (20%$_{\text{external}}$ $>$ *every*)
c. ‘Every tax year, the government audits 20% of the international companies.’ (*every* $>$ 20%$_{\text{internal}}$)
d. ‘There are 20% of international companies x such that the government audits x every tax year.’ (20%$_{\text{internal}}$ $>$ *every*)

(39c) and (39d) show that the universal quantifier can take wide scope or narrow scope with respect to the relative measure phrase with the NP-internal reading. However, it cannot take narrow scope when the relative measure phrase has a NP-external reading, as in (39b).

In the literature, there are several formal analyses offered to capture weak island effects. Szabolcsi and Zwarts (1992) propose that weak islands can be understood if we pay attention to the Boolean operations that particular quantificational elements are associated with. For example, universal quantification corresponds to ‘meet,’ existential quantification ‘join’ and negation ‘complementation.’ A sentence is not acceptable if a quantificational element in this sentence needs to perform its corresponding Boolean operation on an algebraic structure for which the operation is not defined. Doetjes and Honcoop (1997) follow this analysis and argue that complementation and meet cannot be performed on the domain of event-individual pairs. They assume that the domain of event-individual pairs constitutes a join semi-lattice (see Section 3.1). This essentially follows from the fact that the domain of events has no bottom element. Consequently, the domain of event-individual pairs does not have a bottom element either. In (38b) and (39b), the negation and the universal quantifier performs complementation and meet on the domain of event-individual pairs. Since there is no bottom element in this domain, complementation and meet are undefined.

Besides the algebraic semantic approach, Honcoop (1998) and Abrusán (2014) propose two other alternative approaches to weak island effects. The former relies on dynamic semantics, while the latter is based on the semantic and pragmatic properties of questions. The current study remains open to these alternative approaches. The crucial point is that the weak island sensitivity of the NP-external reading provides another piece of evidence for my analysis that this reading is event-related.

7. A previous approach: Focus mapping

In this section, I compare my analysis with Ahn and Sauerland’s studies on relative measurement (Sauerland 2014; Ahn and Sauerland 2015a, b). Following the Focus Mapping Hypothesis (Herburger 2000; Beaver and Clark 2008; a.o.), they propose that the NP-external reading of relative measurement is derived by focusing on the NP complement of a relative measure item. For example, in (40), the NP complement is focused.

(40) Lianxiang gu-le 30% de [bendiren]$_F$.
Lenovo hire-ASP 30% DE local
'Lenovo hired 30% [locals]$_F$.' (NP-external)

According to the Focus Mapping Hypothesis, focus determines the structure of a quantificational element: focused materials are mapped onto the scope, while non-focused materials are mapped onto the restriction. Therefore, in (40), the quantificational structure induced by the relative measure item *30%* can simply be represented as follows:

(41) $[30\%\ x : \textbf{Lenovo-hired}(x)]\ \textbf{locals}(x)$

Although the focus approach is elegant and based on a widely assumed hypothesis, it faces some empirical problems. First, it cannot account for the event-related properties discussed in this paper. Under the focus approach, both the NP-internal reading and the NP-external reading are individual-related. As a result, the contrasts involving counting recycled individuals, the monotonicity constraint and weak island sensitivity cannot be easily captured in this approach.

Second, at least in Mandarin, focus is not required to derive the NP-external reading. Consider the question-answer pair in (42).

(42) a. Lianxiang qunian gu-le duoshao bendiren?
Lenovo last.year hire how.many locals
'How many locals did Lenovo hire last year?'
b. Lianxiang qunian gu-le [30%]$_F$ de bendiren
Lenovo last.year hire-ASP 30% DE locals
(i) 'Last year, Lenovo hired 30% of the locals.' (NP-internal)
(ii) 'Last year, Lenovo hired 30% locals.' (NP-external)

In a question-answer pair, the constituent in the answer corresponding to the *wh*-word is the focus (Jackendoff 1972; a.o.). Accordingly, in (42a), *30%* should be the focus since it directly corresponds to the *wh*-word of the preceding question. Its NP complement as a piece of repeated information is not focused. However, (42b) is still ambiguous, i.e., the NP-external reading is available even though the NP complement of a relative measure item does not bear focus.

8. Conclusion

This paper takes up relative measurement in Mandarin. It is argued that relative measurement may involve event-related measurement or individual-related measurement. Furthermore, an explicit compositional analysis is offered to derive these two readings. The analysis is shown to account for various contrasts between individual-related relative measurement and event-related relative measurement. My analysis also highlights the similarities in NP-internal elements with an external event-related interpretation.

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Mandarin *dou*: The common core of distributivity, maximality, and EVEN[1]

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Abstract. The paper presents a unified analysis of Mandarin *dou* as an alternative-sensitive (sentential) operator whose semantics equals to Karttunen and Peters (1979)'s EVEN. Different 'uses' of *dou* are analyzed by associating *dou* with different types of alternative sets: *even-dou* involves non-entailment-based alternative sets, while distributive-*dou* entailment-based ones.

Keywords: distributivity, maximality, *even*, Mandarin *dou*.

1. Introduction

Mandarin *dou* is well discussed in the literature (Lee 1986; Cheng 1995; Shyu 1995; Huang 1996; Lin 1998; Hole 2004; Chen 2008; Xiang 2008; Cheng 2009; Dong 2009; Liao 2011; Xiang 2016, a.o.). This very short paper will not examine every claim previously made concerning *dou*. Instead, it starts from a simple *dou* sentence as in (1) and checks it against two influential accounts of *dou*. It then shows that neither treating *dou* as a distributivity operator (Lin 1998; Chen 2008) nor taking it to be a maximality operator (Giannakidou and Cheng 2006; Xiang 2008) captures all aspects of (1). It then proposes that *dou* is an alternative-sensitive operator (cf. Liao 2011; Xiang 2016); specifically, it is EVEN. Different interpretations of a *dou* sentence are explained by associating *dou* with alternative sets of different properties: EVEN-*dou* corresponds to a (propositional) alternative set whose members stand in a likelihood relation, while DISTRIBUTIVE-*dou* corresponds to an alternative set based on entailment.

(1) San.ge xuesheng <u>dou</u> mai.le shi.ben shu.
three-CL student DOU buy.ASP ten.CL book
  a. EVEN-*dou*: 'A group of three students together bought 10 books, which is <u>unlikely</u>.'
  b. DISTRIBUTIVE-*dou*: '<u>The</u> three students <u>each</u> bought 10 books.'

Let me introduce the basic facts of *dou* exhibited in (1). (1) is ambiguous between (1a) and (1b) (with stress disambiguating the two).[2] Under (1a), *dou* adds an *even*-flavor and the sentence is interpreted collectively (the collective-cumulative distinction is irrelevant to our discussion), while in (1b) *dou* is *even*-less but triggers a distributive effect (Lin 1998) and a maximality effect (see especially Cheng, 2009: 67), indicated by the *each* and *the* in the gloss respectively.

2. Two previous accounts

2.1. *Dou* as a distributivity operator

Lin (1998) takes *dou* to be Link (1987)'s distributivity operator, as in (2). Being a predicate

[1]This paper reports some of the results of Liu (2017). I thank the persons acknowledged there, as well as reviewers and participants (Brian Buccola, Martina Faller, Yael Greenberg, Bernard Schwarz, Eytan Zweig) at SuB 21 for helpful discussion and comments. All errors are my own.

[2]Specifically, putting stress on *san* 'three' facilitates (1a) while stressing *dou* renders (1b). The paper will leave to another occasion an explanation of this fact at the semantics-prosody interface.

modifier, *dou* turns a mixed predicate such as *bought ten books* into a strictly distributive one, *each bought ten books* in this case.

(2) $[\![dou_{Lin}]\!] = \lambda P \lambda X \forall y[y \leq X \wedge Atom(y) \rightarrow P(y)]$

While (2) straightforwardly explains the *each* in (1b), it fails to capture *dou*'s maximality/definiteness effect in the same environment — the *the* in (1b). Importantly, bare numerals such as *san.ge xuesheng* 'three students' in other contexts are not interpreted as definites in Mandarin. This is already evidenced by (1a) which can be felicitously (and truthfully) uttered in a context where there were more than three students in the context but only three bought books, and the three book-buyers together bought ten books.

2.2. *Dou* as a maximality operator

The maximality aspect of *dou* has been emphasized in Xiang (2008) and Cheng (2009), who follow Giannakidou and Cheng (2006) analyzing *dou* as a maximality operator as in (3).

(3) $[\![dou_{G\&C}]\!] = \lambda P.\sigma x P(x)$[3]

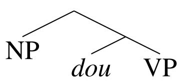
(3) is essentially what Sharvy (1980) and Link (1983) posit for the meaning of the definite article in English. It thus directly captures the maximality/definiteness effect of *dou* in (1b) (with *three* treated as having an adjectival semantics $\lambda P \lambda X.|X| = 3 \wedge P(X)$).[4]

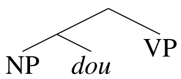
However, remember that (1b) also shows the distributive effect. It only has the distributive reading that the three students each bought ten books; it lacks the collective reading that the three students together bought ten books. This is not captured by treating *dou* as a definite determiner/maximality operator.

In sum, neither the distributivity operator analysis nor the maximality operator analysis captures the behavior of *dou* in (1b). Additionally, neither of the two offers a ready explanation of *dou*'s *even*-flavor in (1a).

[3]Giannakidou and Cheng (2006) and Cheng (2009) use ι, while following Link (1983) I use σ. I also ignore intensionality. Finally, Giannakidou and Cheng do not specify the semantics of σ explicitly. I adopt the standard treatment: $\sigma x.P(x)$ is defined if $\bigoplus P \in P$, and if defined $\sigma x.P(x) = \bigoplus P$, following Sharvy (1980).

[4]We also need to tamper with the syntax. Instead of having the structure in (ia), which is required by a distributivity operator analysis of *dou* and agrees with *dou*'s adverbial status, we need (ib) to make (3) work (see especially Giannakidou and Cheng 2006: (78)).

(i) a.


b.


3. *Dou* as EVEN

We present a unified analysis of Mandarin *dou* that captures not only its distributive and maximality effects in (1b), but also its *even*-flavor in (1a). The central idea is that *dou* is just EVEN, with the semantics of English *even* proposed in Karttunen and Peters (1979) (cf. Liao 2011: 217). In (4), π stands for the prejacent of *dou*, and $[\![\pi]\!]^{Alt}$ its alternative semantic value (Rooth, 1985, 1992), a set of propositions in this case. Notice that I assume for simplicity that *dou* takes sentential scope, which could be achieved either by movement of *dou*, similar to movement of *even* (Wilkinson 1996, Karttunen and Peters 1979, Lahiri 1998, Crnič 2014), or by making *dou* an indicator of a covert *even* that has sentential scope (Liao, 2011: 215). In the latter view, *dou* does not have its own meaning. The paper adopts the movement view as in (5), but nothing crucial hinges on this. Finally, I take it that in (1), *three* is the alternative trigger (evidenced by the prosodic profile of (1a), see footnote 2), and I use $_F$ to mark it.

(4) $[\![dou(\pi)]\!]$ is defined
iff $\forall q \in [\![\pi]\!]^{Alt}[\neg([\![\pi]\!] = q) \rightarrow [\![\pi]\!] \prec_{likely} q]$
if defined, $[\![dou(\pi)]\!] = [\![\pi]\!]$ (Karttunen and Peters, 1979)
In words: *dou* is truth conditionally vacuous but presupposes that its prejacent is the most unlikely proposition among its alternatives (we set aside the additive presupposition of *even*).

(5) [*dou* [$_{\pi}$ three$_F$ students bought ten books]]

Treating *dou* as EVEN naturally accounts for its *even*-flavor in (1a). (6) below is the alternative set I propose for (1a) (with *san.ge xuesheng* 'three students' interpreted as standard existentials, hinted by the *there were* ... in (6)). The prejacent indeed seems to be the most unlikely one among its alternatives.

(6) $$[\![\pi_{(1a)}]\!]^{Alt} = \left\{ \begin{array}{l} \ldots \\ \text{three were 5 students such that they together bought 10 books,} \\ \text{there were 4 students such that they together bought 10 books,} \\ \text{there were 3 students such that they together bought 10 books } (= \pi) \end{array} \right\}$$

Two questions arise at this point. First, why is the proposition *that there were 2 students such that they together bought 10 books*, which presumably is more unlikely than the prejacent, not in (6)? I think the answer has to do with contextual pruning. The same process would explain the felicity of *she even made it to the semi-finals$_F$*, even though *that she made it to the finals* is more unlikely (Kay, 1990).

A second question involves the obligatory collective reading of (1a). Why is the distributive reading not allowed with *dou*'s *even*-flavor? The next subsection is devoted to answering this question.

3.1. *Even*-less *dou*'s distributive effect

Let me first clarify my assumption about distributive readings. I analyze distributive readings by a covert distributivity operator (7) optionally on VP (Link, 1987).

(7) $[\![Dist]\!] = \lambda P \lambda x \forall y[(y \leq x \wedge Atom(y)) \rightarrow P(y)]$

The existence of a covert distributivity operator in Mandarin Chinese is independently justified by (8a), where *dou* is absent but a distributive reading is possible and strongly preferred for every speaker consulted. In this respect, our judgment agrees with Xiang (2008: 229), but differs from Lin (1998: 201), who claims that (definite) plurals in Mandarin do not have distributive readings, unless *dou*, according to Lin a distributivity operator, is added. However, it seems that Lin did not take context into consideration. For (8a), even Lin himself (personal communication) agrees that a distributive reading is the preferred one. Below, (8b) and (8c) spell out the LF and semantics of (8a).

(8) a. (Context: I asked who among the kids drew two pictures; you replied:)
Zhangsan he Lisi hua le liang fu.
Zhangsan and Lisi draw ASP two CL
'Zhangsan and Lisi each drew two pictures.'
b. $[_{\text{TP}}$ Zhangsan and Lisi $[_{\text{VP}}$ *Dist* $[_{\text{VP}}$ drew two pictures $]]]$
c. $\forall y[(y \leq \mathsf{z} \oplus \mathsf{l} \wedge Atom(y)) \rightarrow \exists X[|X| = 2 \wedge \mathsf{pics}(X) \wedge \mathsf{draw}(y,X)]]$

With *Dist*, the prejacent of *dou* in (1)/(5) can be interpreted distributively. Specifically, I propose that (9) is the alternative set associated with *dou* in (1b), with *each* representing the distributivity operator *Dist*.

(9) $$[\![\pi_{(1\text{b})}]\!]^{Alt} = \left\{ \begin{array}{l} \text{there were 3 students such that each bought 10 books } (= \pi), \\ \text{there were 2 students such that each bought 10 books,} \\ \text{there were 1 students such that each bought 10 books,} \end{array} \right\}$$

Note that the propositions in $[\![\pi_{(1\text{b})}]\!]^{Alt}$ stand in a very interesting relation: *dou*'s prejacent π logically (asymmetrically) entails all the other alternatives.

We have proposed that *dou* is EVEN, whose semantics requires that the prejacent π be less likely than all π's alternatives. But entailment is stronger than likelihood: if p entails q, p is at least as unlikely as q (Lahiri, 1998; Crnič, 2014). Thus, the EVEN-presupposition of *dou*, which essentially is a requirement on the shape of its alternative set, is weaker than what we already know about the $[\![\pi_{(1b)}]\!]^{Alt}$ and is automatically satisfied.[5] In this case, the *even*-flavor is trivial (cf. Liao 2011).

In other words, when the alternatives all stand in an entailment relation with the prejacent of *dou*, *dou*'s *even* presupposition can be trivialized.[6] Crucially, since the entailment is made possible by the distributive operator (the *each* in (9)), the correlation between *even*-less *dou* and distributive readings is observed. This, I claim, is how *dou*'s *even* meaning could disappear in a distributive context in (1b), and the distributive effect of *even*-less *dou* is explained.

This also explains why (1a) is obligatorily collective. Only by being collective can the alternatives avoid standing in an entailment relation with the prejacent (*that 3 students together bought 10 books* has nothing to do with *that 4 students together bought 10 books*), and consequently likelihood and the *even*-flavor could surface.

3.2. *Even*-less *dou*'s maximality effect

The maximality/definiteness effect of *dou* also follows from our proposal. To illustrate, consider contexts where there are exactly three students. In such contexts, any alternative of the form *there were n students such that each bought 10 books* with $n > 3$ won't be included in the actual alternative set. This is because it does not make sense to consider a proposition like *that there were 4 students such that each bought 10 books* if we already know there could only be three students. Thus, the alternative set has to be the one in (9) and we have already seen how *dou* is licensed there without triggering an *even*-flavor.

Things change when there were more than three students in the context. Suppose there were four as in (10). In this case, there is a proposition q in the alternative set entailing the prejacent; *dou*'s presupposition then cannot be satisfied (again, if p entails q, q cannot be more unlikely than p) and the sentence is thus infelicitous in the context.

[5] We also need to assume that non-equivalent propositions within $[\![\pi_{(1b)}]\!]^{Alt}$ have different likelihood, which I take to be satisfied by normal contexts.

[6] A few more words on *dou*'s *even*-flavor and its disappearance in distributive contexts. When I said *dou*'s *even*-flavor is trivialized, I meant its (un)likelihood-flavor is indiscernible — that is, we do not feel any relation based on (un)likelihood between *dou*'s prejacent and its alternatives, and this is, I argued, due to the existence of a stronger entailment relation among the alternatives, because of distributivity. Some readers may find this intuitively hard to digest, but I believe the reason has to do with our choice of using comparative likelihood as the scale the semantics of *even* (and thus of *dou*) is based on (Karttunen and Peters, 1979). Several authors however argue that the scale of *even* should really be based on "pragmatic entailment", "better informativeness" (Kay, 1990), "noteworthiness" (Herburger, 2000), or simply a contextually determined scale (Greenberg, 2016). With these theories, the disappearance of likelihood of *dou* in entailment contexts is more transparent: when entailment is available, *dou*'s prejacent can be the most noteworthy/informative by logically entailing all the other alternatives; only when entailment is unavailable is likelihood needed to make sense of noteworthiness/better informativeness. I take the above reasoning to be a variant of the idea presented in the main text, but I will stick to the proposal made above, trading popularity (of Karttunen and Peters (1979)'s semantics) for transparency.

(10) $$[\![\pi_{n>3}]\!]^{Alt} = \left\{\begin{array}{l}\text{there were 4 students such that each bought 10 books } (= q),\\ \text{there were 3 students such that each bought 10 books } (= \pi),\\ \text{there were 2 students such that each bought 10 books,}\\ \text{there were 1 students such that each bought 10 books,}\end{array}\right\}$$

In other words, to get the *even*-less *dou* in (1b), the context has to contain exactly 3 students.[7] In this way, we have derived the maximality/definiteness effect of *dou* in (1b) from its *even* presupposition.

4. Concluding remarks

By examining a single *dou* sentence, the paper has sketched an analysis of Mandarin *dou* that captures its *even*-flavor, its distributive effect, its maximality effect, and the interaction among the three. For a detailed exposition of the analysis, its theoretical implications to the theory of pluralities and the theory of alternatives, and a comparison of the analysis with its close relative Liao (2011), the interested reader is referred to Liu (2017).

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A solution to Karttunen's Problem[1]

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Abstract. There is a difference between the conditions in which one can felicitously assert a 'must'-claim versus those in which one can use the corresponding non-modal claim. But it is difficult to pin down just what this difference amounts to. And it is even harder to account for this difference, since assertions of ⌜Must φ⌝ and assertions of φ alone seem to have the same basic goal: namely, coming to agreement that $[\![\varphi]\!]$ is true. In this paper I take on this puzzle, known as *Karttunen's Problem.* I begin by arguing that a 'must'-claim is felicitous only if there is a shared argument for its prejacent. I then argue that this generalization, which I call *Support*, can explain the more familiar generalization that 'must'-claims are felicitous only if the speaker's evidence for them is in some sense indirect. Finally, I sketch a pragmatic derivation of *Support*.

Keywords: epistemic modals, indirectness of 'must', Karttunen's Problem, strength of 'must'.

1. Introduction

Compare (1) and (2):

(1) It must be raining out.

(2) It is raining out.

Intuitively, an assertion of (1) and an assertion of (2) have the same basic aim: they are both proposals to accept that it is raining out. Once an assertion of (1) has been accepted, interlocutors are disposed to accept the content of (2): that it is raining out. Thus (1) seems to be *as strong as* (2). But it does not seem to be *stronger* than (2): it is very strange to assert (1) after (2) is already accepted, as witnessed by the oddness of (3):

(3) ??It's raining; and moreover, it must be raining.

This suggests that assertions of (1) and (2) carry the same basic information. Yet the conditions under which they can be felicitously asserted differ in subtle ways. Suppose that Jane is in a windowless room, and sees her colleagues come in with wet umbrellas. Then she can assert either (1) or (2). But now suppose that Jane is looking out a window at the rain. She can still assert (2), but an assertion of (1)—'It must be raining out'—would be decidedly odd.

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Generally there exists a systematic difference between the conditions in which one can felicitously assert a 'must'-claim with complement φ, versus the conditions in which one can felicitously assert φ alone.[2] This puzzle, known as *Karttunen's Problem*,[3] gets to the heart of a number of broad foundational questions concerning the meaning of epistemic modals and the structure of conversation, and will be the topic of this paper.

The argument of the paper comes in three parts. In §2, I get clear on the data: what exactly the difference in felicity conditions between sentences like (1) and (2) amounts to. The main claim in the literature, which I call *Indirectness*, is that a 'must'-claim is felicitous only if the speaker's evidence for its prejacent is *indirect*, whereas its bare prejacent can be asserted whether the speaker's evidence is direct or indirect. I argue that, while *Indirectness* is correct, there is another, equally important, generalization which plays a key role in solving Karttunen's Problem: namely, that a 'must'-claim is felicitous only if the speaker ensures there is a salient argument in support of the claim's prejacent. I call this constraint *Support*. In §3, I show that once we have *Support* clearly in sight, we can derive *Indirectness* through general pragmatic reasoning. In §4, I give a Gricean account of why *Support* arises in the first place. This solution to Karttunen's Problem predicts that assertions of $\ulcorner$Must $\varphi\urcorner$ and φ have the same basic update effect, while explaining why the former, but not the latter, requires that the speaker share an argument for $[\![\varphi]\!]$, and that her evidence for $[\![\varphi]\!]$ be indirect.

2. The data

The main extant claim regarding the difference between an assertion of $\ulcorner$Must $\varphi\urcorner$ versus an assertion of φ alone is that it amounts to an *Indirectness* constraint:[4]

> *Indirectness:* A claim of $\ulcorner$Must $\varphi\urcorner$ is felicitous only if the speaker's evidence for $[\![\varphi]\!]$ is indirect; a claim of non-modal φ can be felicitous whether the speaker's evidence for $[\![\varphi]\!]$ is direct or indirect.

Indirectness is motivated by considering pairs of sentences like (4a) and (4b):

(4) a. It must be raining.
    b. It's raining.

First suppose that the speaker of (4a) is looking out at the rain. Then her assertion is distinctly odd; whereas if she said (4b), it would be unmarked. By contrast, if she has a piece of indirect evidence for rain—say, wet umbrellas—then either is felicitous. *Indirectness* is the most natural generalization to draw from data like these.

Indirectness partly characterizes the difference in felicity between $\ulcorner$Must $\varphi\urcorner$ and φ, but does it exhaust that difference? Most of the literature on Karttunen's Problem has indeed focused exclusively on *Indirectness*. But a different, mostly neglected, thread has pointed to a further

[2] A *'must'-claim* is a claim containing an unembedded strong epistemic necessity modal.

[3] Following von Fintel and Gillies (2010), who credit Karttunen (1972) with bringing the issue to attention.

[4] Karttunen (1972), Veltman (1985), Kratzer (1991), von Fintel and Gillies (2010), Kratzer (2012), Matthewson (2015), Lassiter (2016), Giannakidou and Mari (2016), Sherman (2016).

contrast in felicity conditions between ⌜Must φ⌝ and φ: in making a 'must'-claim, the speaker must ensure that an *argument* for its prejacent is salient to all the interlocutors.[5]

> *Support*: A claim of ⌜Must φ⌝ is felicitous only if there is an argument for $[\![\varphi]\!]$ salient to all the interlocutors; a claim of non-modal φ can be felicitous whether or not there is a salient argument for $[\![\varphi]\!]$.

The data that motivate *Support* are less clearcut than those that motivate *Indirectness*. This is unsurprising: evaluating *Support* requires evaluating discourses as a whole, rather than single utterances, and it can be difficult to determine, in a given context, whether an argument has been made salient. In the remainder of this section, I will provide new data to argue that *Support* is indeed required to account for the difference in felicity conditions between ⌜Must φ⌝ and φ.

Consider the following case:

(5) Patch the rabbit sometimes gets into the box where her hay is stored. On his way out, Mark hears a snuffling from the box. At work, Bernhard asks him how Patch is.
  a. [Mark:] She's great. She must have gotten into the hay box this morning.
  b. [Bernhard:] Cute!

Suppose the conversation ends here, and assume that Bernhard doesn't know anything about Patch's set-up at Mark's house, or anything else which might help him figure out why Mark thinks that Patch was in the box of hay. There is something distinctly odd about this exchange. Intuitively, what Mark has said needs elaboration; either Mark should have proffered reasons to think that Patch was in the hay box, or Bernhard should have asked him for reasons, perhaps with, 'Why do you say that?' Here is a more felicitous version of (5); assume the same setup:

(6) a. [Mark:] She's great. I heard a snuffling from the box of hay on my way out—she must have gotten into the box.
  b. [Bernhard:] Cute!

Now suppose the conversation ends here. This exchange has none of the peculiarity of (5). Likewise, a non-modal variant of (5) is perfectly fine:

(7) a. [Mark:] She's great. She got into the box of hay this morning.
  b. [Bernhard:] Cute!

The infelicity of (5) thus seems to be due to the fact that a 'must'-claim is made while no argument for its prejacent is given.

Cases like this provide our first piece of evidence for *Support*. To get another case of this kind on the table, consider (8), adapted from Murray (2014):

[5] See especially Stone 1994.

(8) On her way to a meeting in a windowless building, Sarah sees Jim enter with a wet umbrella. Sarah enters the meeting. Thomas, who didn't see the umbrella, asks 'What's the weather like?' Sarah responds:
  a. It must be raining out.
  b. It's raining out.
  c. It must be raining out; I just saw Jim come in with a soaking wet umbrella.
  d. It's raining out; I just saw Jim come in with a soaking wet umbrella.

  Thomas replies: 'Oh, too bad. Ok, let's talk about the agenda for this meeting.'

If the conversation ends here, then (8a)—the variant with a 'must' and no argument—is odd, while the other variants are fine—again, just as *Support* predicts.

Comparing 'must' with other words that might at first glance seem to work in a similar way can help bring out the plausibility of *Support*. Consider (9), adapted from a television spy drama:

(9) a. The suspect is fleeing south. We've sent agents ahead to Mattapan.
  b. Why Mattapan?
    (i) Apparently the Russians have a safe-house there.
    (ii) The Russians must have a safe-house there.

If the conversation ends here, then (9bii) is peculiar in a way that (9bi) isn't. 'Apparently', like 'must', is constrained by a form of *Indirectness*; but 'apparently', unlike 'must', is acceptable here without an argument. *Support* predicts precisely this contrast (assuming that no corollary governs 'apparently').

Finally, I note that the patterns reported here are robust across strong epistemic necessity modals, in English and in all the other languages I have checked.[6]

I thus conclude that we should adopt *Support* as part of our characterization of the difference in felicity conditions between a 'must'-claim and its bare prejacent. Before moving on, let me say more about what *Support* amounts to. First, what does an *argument* amount to? I will think of an argument for $[\![\varphi]\!]$ in a particular context as a set of propositions which the speaker is commonly recognized to believe provides reason to believe $[\![\varphi]\!]$—either by deductively entailing its conclusion; by inductively supporting the conclusion; or by showing how the conclusion follows from what is already accepted.

Second, what does 'salience' amount to? I won't say much about this, but a few features are worth noting. First, an argument need not itself be commonly accepted (i.e. *common ground* (Stalnaker, 1970)). One can felicitously assert an argument conjoined with a 'must'-claim, even if the argument has not yet been (and never is) accepted by all the speakers (if Bernhard doesn't believe me that I heard a snuffling from the box of hay, this does not render (6) infelicitous). The sense in which an argument Γ must be salient is rather that it must be common ground that the speaker takes Γ to provide reason to believe the prejacent of her 'must'-claim, and that she

[6]Bengali, French, German, Hindi, Japanese, Russian, Spanish, Swiss German, and Turkish.

is proposing to add Γ to the common ground. I will refer to an argument with this status as 'salient' or 'shared' or 'publicly available'.

An important point about salience is that an argument can be salient without being made explicit. If Bernhard and Mark can both hear snuffling from the box of hay, then Mark can say 'Patch must be in the hay box', without any further argument. Here, the premise that merits Mark's conclusion—that Mark can hear snuffling from the box—is sufficiently salient, rendering the 'must'-claim acceptable. Similarly, arguments can sometimes be *accommodated*, provided it is clear enough from the context what the speaker has in mind.

Another noteworthy feature of salience is that the argument in question need not be salient *at the time of the assertion*; it can be provided shortly after the assertion, as in (10):[7]

(10) a. [Mark:] Patch must have gotten into the box of hay.
b. [Bernhard:] Why do you say that?
c. [Mark:] I heard her snuffling around when I was leaving.

3. Explaining *Indirectness* via *Support*

Support, in addition to *Indirectness*, is thus necessary to characterize the difference in felicity conditions between a 'must'-claim and its bare prejacent.[8] How should we explain these differences? There are three possible strategies: account for *Indirectness* and *Support* separately; account for *Support* in terms of *Indirectness*, and give an independent account of *Indirectness*; or account for *Indirectness* in terms of *Support*, and give an independent account of *Support*. I will briefly arguing against the first two strategies and then pursue the third.

3.1. Against the first two strategies

Considerations of theoretical parsimony tell against the first strategy. What about the second? This strategy is *prima facie* attractive, since there are a number of extant attempts to give an independent account of *Indirectness*; it is natural to try to recruit them to explain *Support*. But there are two significant problems with this approach. The first is that I do not believe that extant accounts of *Indirectness* are satisfying. I will not make this case here, however, because a second, simpler point suffices to show that the second strategy is wrong-headed: there does not seem to be any way to reduce *Support* to *Indirectness*.

A natural first thought is that this reduction would go by way of a general pragmatic constraint that requires a speaker to share her evidence for a claim if that evidence is indirect. But there is no such pragmatic constraint, as we saw in cases above where non-modal claims were felicitous without shared evidence. A closely related thought is that there is a general pragmatic constraint which requires a speaker to share her evidence if she explicitly indicates the source of her

[7] As for other constructions that require something to be made salient, like anaphora resolution.
[8] I will not take a stand on the further question of whether they are jointly sufficient.

evidence.[9] But, again, as the example above with 'apparently' shows—and as cross-linguistic work on evidentials suggests (see Murray (2014))—there is no such constraint: one can use 'apparently' or evidential marking without sharing what your evidence is.

A natural second thought is that *Support* reduces to a requirement to assure your interlocutors that *Indirectness* is satisfied. But this approach is not plausible, for a few reasons. First, the cases given above that are felt to be infelicitous without an argument—Patch in her box, Sarah in her windowless office building, the Russian safe-house—there is simply no reason to worry that the speaker's evidence might not be indirect. Second, it is not generally true that whenever a formulation is constrained by a form of *Indirectness*, the speaker must habitually share her evidence in order to reassure her interlocutors that it satisfies the constraint in question: again, we saw this in (9) with 'apparently', which is governed by an *Indirectness* constraint, but which doesn't require a shared argument.[10] Finally, from a more theoretical standpoint, it is hard to see why an *Indirectness* constraint would ever directly yield an obligation to share one's evidence: we are fairly charitable in assuming that speakers are complying with felicity conditions. For instance, if *Indirectness* were encoded as a presupposition, then, on a standard approach to presuppositions, it will be required that it be common ground that the speaker's evidence for the prejacent is indirect. But in general interlocutors are perfectly happy to *accommodate* presuppositions,[11] leaving it puzzling why *Indirectness* would lead to a requirement for a speaker to share her evidence.

3.2. Deriving *Support* from *Indirectness*

I thus do not see a promising way for the second strategy to go. By contrast, I will argue now that the third strategy—deriving *Indirectness* from *Support*, and then giving an independent explanation of the latter—provides a satisfying solution to Karttunen's Problem. In brief, the idea is as follows. I argue that an assertion of $\ulcorner$Must $\varphi\urcorner$ is a bid to update the common ground with $[\![\varphi]\!]$. *Support* then says that it is a proposal to do so *on the basis of an argument* Γ. General principles forbidding redundant assertions entail that $[\![\varphi]\!]$ should not follow from Γ in a way that is mutually recognized to be obvious. Finally, speakers are generally obligated to give their best argument for $[\![\varphi]\!]$ if they're giving an argument for $[\![\varphi]\!]$ at all. It follows that, in order for an assertion of $\ulcorner$Must $\varphi\urcorner$ to be felicitous, $[\![\varphi]\!]$ should not follow in a mutually obvious way from the best argument a speaker of $\ulcorner$Must $\varphi\urcorner$ can have for $[\![\varphi]\!]$; in other words, a form of *Indirectness*.

The first step in our derivation is the assumption that an assertion of $\ulcorner$Must $\varphi\urcorner$ is *pragmatically strong* in the sense that it is just as strong as an assertion of φ. Following Stalnaker (1978), I assume that an assertion of φ is a proposal to update the common ground with $[\![\varphi]\!]$. Then we can spell out *Pragmatic Strength* as saying that an assertion of $\ulcorner$Must $\varphi\urcorner$ is, *inter alia*, a proposal to update the common ground with $[\![\varphi]\!]$:

[9] Thanks to Justin Bledin for discussion.

[10] And, again, Murray (2014) likewise observes that grammatical evidential markers for indirectness do not give rise to any obligation to share one's evidence.

[11] See e.g. Lewis (1979), Stalnaker (2002) and many others.

> *Pragmatic Strength*: An assertion of ⌜Must φ⌝ is as strong as an assertion of φ, in the sense that once the common ground is updated with $[\![\text{Must } \varphi]\!]$, it is updated with $[\![\varphi]\!]$.

Pragmatic Strength says that conversants do not typically leave open the possibility of $[\![\neg\varphi]\!]$ after accepting ⌜Must φ⌝. To see its plausibility, note the weirdness of (11b) and (11c) as responses to (11a):

(11) a. The gardener must be the murderer.
b. I concur. Moreover, the gardener is the murderer.
c. I concur. Let's bring him and the butler in to see if we can pin down which of them is the murderer.

Pragmatic Strength provides the most natural explanation of the infelicity of (11b) and (11c).

The second step is to note that in general, when a speaker tries to get her interlocutors to accept $[\![\varphi]\!]$ on the basis of an argument, the argument must be *non-redundant* in a relevant sense. Compare the two variants in each of (12) and (13):

(12) a. I put Patch in her box this morning, and no one has let her out. So she's in her box.
b. ??I see Patch in her box. So she's in her box.

(13) a. Clinton has amassed a majority of pledged delegates and superdelegates. So a woman will clinch the Democratic nomination!
b. ??Clinton will clinch the Democratic nomination. So a woman will clinch the Democratic nomination!

Without further justification for their repetitiveness, there is something pedantic or redundant about (12b) and (13b). By contrast, (12a) and (13a) are fine. The difference seems to be that in (12a) and (13a), there is enough epistemic space left between the argument in the first sentence and its conclusion in the second that its conclusion is not felt to be redundant. This intuition can be regimented as a norm against redundant assertions, along the following lines:

> *Non-Redundancy*: A proposal to update the common ground with $[\![\varphi]\!]$ on the basis of an argument Γ is infelicitous if $[\![\varphi]\!]$ follows from Γ in a way that is mutually recognized to be obvious.

Non-Redundancy nicely captures the contrast between (12a) and (12b). The first is acceptable, since having put Patch in her box in the morning, together with no one else having let her out, does not, in an intuitive sense, obviously entail that Patch is in the box. The second is not, since it does follow in a mutually obvious way from seeing Patch in her box that she is in her box. Likewise for (13).[12]

[12] Note that *Non-Redundancy* does not forbid post hoc *support* for an assertion with a redundant argument; it is perfectly fine to justify oneself, if challenged, with 'Because I saw it'. What *Non-Redundancy* forbids is making

The last step in our derivation says that a speaker must give the best argument for $[\![\varphi]\!]$ that she has, if she's giving an argument for $[\![\varphi]\!]$ at all. To see the plausibility of this constraint, consider (14):

(14) John was at the Red Sox game and knows on this basis who won. He also read about the game in the *Boston Globe*.
 a. [Max:] Who won the game?
 b. [John:] ?? The Red Sox, according to the *Globe*.

If John intends (14b) to answer Max's question, then there is something strange about it; we expect John to give his strongest evidence for the claim that the Red Sox won. In general, speakers are required to share the best piece of evidence they have for a claim, if they are sharing evidence at all. This follows naturally from a broadly Gricean vantage point on conversational dynamics. In (14b), John is violating Grice's Maxim of Quantity by failing to 'make his contribution as informative as is required (for the current purposes of the exchange)' (Grice, 1989). More precisely, the general lesson of cases like this is a corollary of the Maxim of Quantity which I call *Strongest Evidence*:[13]

> *Strongest Evidence*: When a speaker aims to update the common ground with $[\![\varphi]\!]$ on the basis of an argument Γ, she is obligated to do so by providing the *strongest* argument—the best piece of evidence—which she has for that claim.

We can now put these pieces together to derive *Indirectness* from *Support*. *Support* says that an assertion of ⌜Must φ⌝ is felicitous only if there is a shared argument for $[\![\varphi]\!]$. *Pragmatic Strength* says that an assertion of ⌜Must φ⌝ is a proposal to update the common ground with $[\![\varphi]\!]$. I will make the plausible further assumption that an assertion of ⌜Must φ⌝ is thus a proposal to update the common ground with $[\![\varphi]\!]$ *on the basis of* a shared argument for $[\![\varphi]\!]$ (this is an assumption that will fall out of the derivation of *Support* below). According to *Non-Redundancy*, $[\![\varphi]\!]$ must not follow from that argument in a mutually obvious way. According to *Strongest Evidence*, that argument must constitute the best evidence the speaker has for $[\![\varphi]\!]$. It follows that in order for a speaker to be able to felicitously assert ⌜Must φ⌝, $[\![\varphi]\!]$ cannot follow in a mutually obvious way from the speaker's best piece of evidence for $[\![\varphi]\!]$. In other words, the speaker's best evidence for $[\![\varphi]\!]$ must be indirect, in the sense of indirectness relevant to evaluating whether an argument is felt to be redundant.

Put differently: Suppose a speaker has direct evidence (in the sense relevant to judgments about redundancy) for $[\![\varphi]\!]$. If she were to assert ⌜Must φ⌝, then due to *Strongest Evidence* and *Support*, she would have to give that evidence as an argument on the basis of which she is proposing her interlocutors accept $[\![\varphi]\!]$; but then she would be bound to violate *Non-Redundancy*. So if she has direct evidence for $[\![\varphi]\!]$, she cannot assert ⌜Must φ⌝.

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an initial bid to update the common ground with something on the basis of an argument from which it follows in a mutually obvious way.

[13] See Faller (2012) for more careful discussion of how this kind of reasoning would go. To spell out *Strongest Evidence* in more detail, we need to be able to access a scale of evidential strength, according to which, say, direct perceptual evidence counts as stronger than any kind of testimonial evidence.

In sum, in asserting ⌜Must φ⌝, the speaker has to ensure there is a shared argument which represents her best evidence for $[\![\varphi]\!]$, and yet is not so strong that it makes the 'must'-claim sound redundant. Thus $[\![\varphi]\!]$ can't follow in a mutually obvious way from her best evidence for $[\![\varphi]\!]$. No parallel constraint follows for non-modal claims—since *Support* requires only that 'must'-claims be supported by an argument—and thus *Support*, plus *Pragmatic Strength*, *Non-Redundancy*, and *Strongest Evidence*, entail a form of *Indirectness*.

3.3. Predictions

The present proposal derives *Indirectness* from general principles about redundant assertions, and thus makes a striking empirical prediction: namely, that S's evidence Γ for $[\![\varphi]\!]$ counts as indirect in the sense relevant to *Indirectness* just in case an assertion of φ following sequential assertions of the elements of Γ does not strike us as redundant. In addition to providing a new explanation for *Indirectness*, this also provides a new characterization of the notion of indirectness involved, an answer which I will now argue provides a better characterization of the data than the natural alternative, according to which 'must' lexically encodes a requirement that the speaker's evidence be indirect in a sense that lines up with intuitions about whether evidence is direct or indirect, and with categories which are encoded by grammatical evidentials (I'll call this 'an evidential approach').

I will highlight a few points. First, the present approach predicts that 'must'-claims based on reliable testimony like (15) will not be acceptable:

(15) ??The website says the movie is at 7:30. So the movie must at 7:30.

Our approach predicts this, since reliable testimony for $[\![\varphi]\!]$ is typically felt to be a redundant argument for $[\![\varphi]\!]$, as shown by examples like (16):[14]

(16) a. What time is the movie?
b. ??The cinema website says that it's at 7:30. So the movie's at 7:30.

By contrast, this is surprising on an evidential approach, since testimony is, intuitively, indirect evidence (it is natural to say that you know that the movie is at 7:30, but that you know *indirectly*, via the website). An evidential approach thus must simply stipulate that testimony 'counts as direct' for the purposes of evaluating 'must'.

The second prediction worth highlighting is that, on the present approach, what counts as redundant in a given context—and thus judgments about the felicity of 'must'—depends on what counts as mutually obvious in that context. Thus, e.g., while (15) is infelicitous out of the blue, it may be felicitous in a context in which the inference from website listings to fact is not generally accepted, as in (17):

[14] *Why* sequences like this are treated as redundant is, of course, an important question for theories of redundancy to address, but one I will not answer here.

(17) Google says that the movie is at 7:30. Websites listing movie times are generally extremely unreliable. Google is extremely reliable, though, so the movie is indeed at 7:30.

Given the felicity of (17), we predict that a 'must'-claim will be felicitous here as well; and indeed, (18) is felicitous:

(18) Google says that the movie is at 7:30. Websites listing movie times are generally extremely unreliable. Google is extremely reliable, though, so the movie must indeed be at 7:30.

More generally, we rightly predict that judgments about the felicity of 'must'-claims depend on what counts as mutually obvious in context. It is not as clear how an evidential approach would predict this, since it does not seem like what counts intuitively as direct versus indirect evidence varies from context to context: our evidence for the time of the movie is equally indirect, in an intuitive sense, in (18) as in (16).

Third, we can explain why 'must'-claims that conclude a complicated argument are generally acceptable, even if the premises of the argument entail its conclusion. Examples of this kind, in particular those involving mathematical or logical claims, are the most puzzling examples for an evidential approach to 'must'. 'Must' is often warranted in mathematical or logical contexts, like (19).[15]

(19) If the set of validities were decidable, then the halting problem would be decidable. The halting problem is not decidable. So the set of validities must be undecidable.

It is not clear what the evidential approach would predict about (19). It is not clear that there is an intuitive sense on which our evidence that the set of validities is undecidable is indirect. Perhaps the evidential approach would claim that evidence for mathematical claims is *always* indirect in the relevant sense. But in addition to being somewhat stipulative, this response runs into trouble when it comes to examples like (20):

(20) ??24 plus 24 must be 48.

If all evidence from mathematics is indirect, then the evidential approach will wrongly predict that 'must' is warranted in (20) and sentences like it. In any case, it is not clear how the evidential approach can distinguish between cases like (19) versus (20). By contrast, our approach can. The conclusion of (19) does not follow in a way that is mutually obvious from the premises, whereas the conclusion of (20) does.

[15]Is the 'must' here epistemic? Some have argued that this 'logical' 'must' is not genuinely epistemic (e.g. Giannakidou and Mari (2016), Goodhue (2016)). Two things militate against this option. First, it is inelegant to multiply modal flavors further than we need to. Second, even if we say that the logical 'must' is not epistemic, we still need a theory of its distribution, since it is not always warranted, even when its complement is a logical consequence of the common ground (as examples like (20) show); simply saying that this 'must' is logical, not epistemic, thus does not yet explain its behavior.

These points confirm the key claim of the present approach to *Indirectness*: what matters for determining whether a 'must' is warranted is not whether the speaker's evidence for it is indirect in a sense which lines up with our intuitions about sources of evidence, or with categories encoded by grammatical evidentials, but rather whether the speaker's evidence for it makes the prejacent *mutually obvious*.

I conclude by discussing a different prediction of the present account. I have proposed that *Indirectness* arises due to conversational norms. It is a hallmark of pragmatic phenomena like this that they can be cancelled, since the underlying conversational norms are generally defeasible. We thus predict that *Indirectness* will be cancelled when one of the underlying norms is not in play. This prediction, again, is borne out, in particular in contexts in which *Strongest Evidence* is not in play because it is overridden by considerations which prevent the speaker from sharing her strongest evidence for $[\![\varphi]\!]$. For instance, suppose that Mary is at Tom's party. She goes out to the street to smoke, where she runs into Ben. She knows Ben wasn't invited to the party, and doesn't want him to know that she was invited. Ben can hear music coming from Tom's place, and asks Mary what's going on at Tom's. Mary wants to communicate that he's having a party, but she doesn't want to share her strongest evidence for this—and doesn't seem to be under any obligation to do so, since she is trying not to hurt Ben's feelings. In this context, she can felicitously assert (21):

(21) Given the music, it must be some kind of party.

(21) may be misleading, but it is perfectly felicitous, despite the fact that Mary's evidence is direct. The prediction of our pragmatic account is thus borne out: *Indirectness* can be violated when one of the underlying pragmatic norms can itself be appropriately ignored.[16]

4. Support

Support plus independently motivated pragmatic principles thus provide a satisfying explanation of *Indirectness*. I turn now to the question of how to account for *Support*. I briefly criticize extant proposals before giving my own account.

4.1. Extant proposals

Support says that 'must' requires that an argument for its prejacent be made salient. A natural first thought about how to account for *Support* is to treat 'must' as containing something like an implicit indexical which refers to an argument: 'must' means roughly 'it follows from *this argument* that…', where the implicit 'this' requires a salient referent. Stone (1994) suggests an account along just these lines: on his approach, 'must' has a lexical argument place which must be saturated by an argument made salient by context. In other words, 'must' denotes a two

[16]It is less clear to me whether similar cases can be constructed in which it is *Non-Redundancy* which is suspended, since *Non-Redundancy* already has an element of context-sensitivity built in (since what counts as 'mutually obvious'—in the objectionable sense relevant here—is itself context-dependent). But if we can find contexts in which it is suspended, then we predict that in those contexts as well, *Indirectness* will be suspended.

place operator, taking an argument and a proposition *p*, which says that the argument provides decisive reason to believe *p*.

But a solution along these lines, natural though it is, does not work. The issue stems from the fact that no parallel to *Support* shows up for unembedded epistemic possibility modals. Consider (22):

(22) Julie's cat has been sneezing a lot lately. Ben asks her how the cat is doing. Julie says:
 a. Not so great. I need to take him to the vet, he might have an upper respiratory infection.
 b. Not so great. I need to take him to the vet, he has an upper respiratory infection.
 c. Not so great. I need to take him to the vet, he must have an upper respiratory infection.

Suppose the conversation ends here. As *Support* predicts, (22c) is infelicitous as it stands, without an argument. By contrast (22a)—like the non-modal variant in (22b)—is perfectly fine here. This suggests that 'might' is not subject to a *Support*-like constraint.

If we took Stone's approach, however, then, provided we assume that 'must' and 'might' are duals, we would predict that 'might' has an anaphoric requirement for an argument, just as 'must' does: if 'might' means 'not must not', then the argument requirement of 'must' will project through negation, and thus 'might' will require a salient argument, too.

We could avoid this by giving up the assumption that 'must' and 'might' are duals, and that 'might' does not have a lexical argument place for an argument. But, crucially, going this way leads to a serious new puzzle. Assuming we treat 'cannot' as equivalent to 'not might', then we will predict that unembedded 'cannot' does not have an anaphoric requirement for an argument any more than unembedded 'might' does. But this is wrong: the same examples we used to motivate *Support* for 'must' above can be used to motivate it for unembedded 'cannot' (*modulo* obvious changes). Thus, for instance, consider (23):

(23) Emma notices that her neighbor Phil hasn't taken in his mail in some time, and concludes that he is out of town. Another neighbor asks if Phil is around. Emma responds:
 a. No, he can't be.
 b. No, he's not.
 c. No, he can't be: no one has taken his mail in for a week.
 d. No, he's not: no one has taken his mail in for a week.

The exchange ends here.

(23a) is marked as compared with the other variants in (23). As with the examples involving 'must', then, 'can't' seems to require that an argument be made salient, in this case not for its prejacent but for its negation.

Thus a lexical derivation of *Support* along the lines Stone suggests faces a dilemma: either treat 'must' and 'might/can' as duals, and wrongly predict that the latter have a *Support*-like requirement; or do not treat them as duals, and wrongly predict that 'cannot' lacks a *Support*-like requirement. This approach thus strikes me as a non-starter.

Similar criticisms extend to the account suggested in Swanson (2015), who builds on Kratzer (1981) in adopting a premise semantics for epistemic modals, with the added requirement that those premises be publicly available. This approach faces the same dilemma. If we treat 'might/can' as the duals of 'must', then this explanation will overgenerate: it will wrongly predict that they are likewise subject to *Support*, since they will likewise require a set of premises to be made public. Alternately, we could abandon duality, but then we cannot explain *Support* for 'cannot'. The present objection can also be extended to a treatment of *Support* as a presupposition.[17] Presuppositions project through negation; thus a presuppositional approach would either treat 'might/can' as duals of 'must', and thus wrongly predict that 'might/can' obey *Support*; or would abandon duality, and once again fail to predict *Support* for 'cannot'.

4.2. *Support* as a manner implicature

We can avoid these problems by deriving *Support* as a pragmatic implicature along the following lines. The derivation depends in part on adopting a semantics for 'must' defended in Stalnaker (2014) and Mandelkern (2016).[18] I will not try to motivate the semantics here in general terms, but here's a sketch. The idea is that 'must' is a universal quantifier over the set of worlds compatible with what is common ground after the 'must'-claim in question has been made and negotiated (either accepted or rejected; call this the *prospective common ground*). $\ulcorner$Must $\varphi\urcorner$ thus means, roughly, $\ulcorner$We will commonly believe $[\![\varphi]\!]$ after this claim is made and assessed$\urcorner$; 'might' is treated as the dual of 'must', and thus $\ulcorner$Might $\varphi\urcorner$ will mean $\ulcorner[\![\varphi]\!]$ is compatible with what we commonly believe, after this claim is made and assessed$\urcorner$.[19] The basic idea is the familiar one that 'might' and 'must' are used to coordinate on what structural properties the context set has. I adopt the present semantics for 'must' partly because I think it is plausible, and partly because it lends itself naturally to the present derivation. A similar derivation of *Support* may well be possible with a different underlying semantics for 'must'; the crucial features of the semantics for present purposes are, first, that it is pragmatically strong; and, second, that it makes salient the question of the interlocutors' collective doxastic relationship to its prejacent. Any semantics for 'must' with these two features will suffice for present purposes.

On the present approach, $\ulcorner$Must $\varphi\urcorner$ and φ alone have the same basic update effect: namely, adding $[\![\varphi]\!]$ to the common ground. $\ulcorner$Must $\varphi\urcorner$ is thus in competition with a different assertion which has the same basic update effect but which is structurally simpler: namely, an assertion

[17] A suggestion due to Eric Swanson (p.c.).

[18] My approach and Stalnaker's differ in some ways, but the differences do not matter for our purposes.

[19] This gloss is only rough, because these constructions embed differently. See Mandelkern (2016) for further discussion. The basic idea for embeddings is that the domain of quantification for embedded 'must' is determined by its *local context*. I will prescind from deciding whether to go in for a factive or a non-factive notion of common ground in spelling out this semantics.

of φ alone.[20] Because φ is structurally simpler,[21] choosing an assertion like $\ulcorner$Must $\varphi\urcorner$ instead requires some explanation. Because the two options have the same update effect, the interlocutors cannot reason that the speaker chose one of them because she didn't know the other, or knew the other was false (as in scalar reasoning). There is, however, an important difference between $\ulcorner$Must $\varphi\urcorner$ versus φ alone: namely, that the former makes salient the question of the interlocutors' collective doxastic relation to $[\![\varphi]\!]$, while the latter does not: it is only about $[\![\varphi]\!]$. There are a variety of ways to make this intuition precise; it doesn't matter for our purposes how we choose between them.[22] For our purposes, we can just treat the question raised by an assertion of any sentence ψ as the two cell partition $\{\psi, \bar{\psi}\}$. Then the question made salient by an assertion of $[\![\varphi]\!]$ is just the question whether $[\![\varphi]\!]$ is true; whereas the question made salient by an assertion of $\ulcorner$Must $\varphi\urcorner$ is the question *whether we will come to commonly accept* $[\![\varphi]\!]$. Given that $\ulcorner$Must $\varphi\urcorner$ has a simpler alternative with the same basic update effect (namely φ), if a speaker chooses to use this more complex expressions, then we will seek an explanation of this fact. Given that the chief difference between $\ulcorner$Must $\varphi\urcorner$ and φ is in the question made salient by each, we will therefore reason that, in choosing the more complex option, she wishes to raise to salience the question of the group's collective doxastic relation to $[\![\varphi]\!]$, and thus the group's reasons for accepting $[\![\varphi]\!]$.

What kind of reason for accepting $[\![\varphi]\!]$ would be worth highlighting in this way? Whenever a speaker proposes to update the common ground with $[\![\varphi]\!]$, this provides *ceteris paribus* reason for her interlocutors to accept $[\![\varphi]\!]$: namely, the speaker's authority. A reason of this kind, therefore, is totally humdrum, and thus not worth highlighting. The use of an assertion like $\ulcorner$Must $\varphi\urcorner$ rather than an assertion of φ alone thus can be justified only if the speaker wishes to highlight a substantial argument for $[\![\varphi]\!]$—i.e., an argument over and above the speaker's authority—on the basis of which the speaker wishes her interlocutors to accept $[\![\varphi]\!]$. In other words (the interlocutors will reason), the speaker wishes them to accept $[\![\varphi]\!]$ on the basis of an argument that is commonly available to them. The speaker must, therefore, ensure that such an argument is salient—either by providing it, or being assured that her interlocutors can recover it from the common ground, possibly by accommodation.

In short: *Support* arises as a manner implicature, thanks to the fact that the speaker chose to propose to accept $[\![\varphi]\!]$ by way of an assertion which makes reference to the interlocutors' doxastic relation to $[\![\varphi]\!]$.

This approach has a number of attractions. First, it derives *Support* from a simple, independently motivated modal semantics, rather than lexical stipulation, and thus explains why *Support* arises for anything that has the meaning of 'must'. Second, it avoids the problem raised

[20]See Degen et al. (2015) for a different manner-implicature based approach to explaining the behavior of 'must'. Like the present approach, that approach relies on the assumption that $\ulcorner$Must $\varphi\urcorner$ is a costly alternative to φ whose use must be somehow explained. In contrast with the present approach, that approach attempts to derive *Indirectness* directly, rather than by way of *Support*, and without adverting to the different QUDs raised by modal vs. non-modal variants.

[21]I will not spell out assumptions about how we calculate which alternatives are relevant. It seems fairly plausible that however we do so, φ will count as a relevant alternative to $\ulcorner$Must $\varphi\urcorner$ (and $\ulcorner\neg\varphi\urcorner$ as a relevant alternative to $\ulcorner$Can't $\varphi\urcorner$); this follows e.g. on the account given in Katzir (2007), according to which alternatives are calculated by the deletion or replacement of nodes at LF.

[22]See Lewis (1988), Roberts (2012) and citations therein.

above for extant approaches. If we treat 'might/can' as duals of 'must', we will predict that the corollary of *Support* will be blocked for 'might/can', but will still be derived for 'cannot'. First, the derivation of a *Support* constraint for 'might/can' will be blocked because a crucial step in our derivation of *Support* was that $\ulcorner$Must $\varphi\urcorner$ has a structurally simpler alternative with the same basic update effect; this obviously does not hold for $\ulcorner$Might $\varphi\urcorner$, which has a very different update effect than φ. And, second, assuming that 'can' and 'might' mean the same thing, and that 'not' scopes over 'can' in 'cannot', the derivation given above will extend immediately to unembedded 'cannot', predicting in particular that *Support* and *Indirectness* arise for the negation of the prejacent of 'cannot', just as they do for the prejacent of 'must'.

Note that for the same reason that this derivation of *Support* is blocked for 'might', the corresponding derivation of *Support* will likewise be blocked for weak epistemic necessity modals like 'ought' and 'should', as well as probability modals, since assertions of $\ulcorner$ought/should/probably $\varphi\urcorner$ and φ do not have the same basic update effect. These predictions again seem correct:

(24) a. When do you want to meet?
  b. Let's say Thursday;
   (i) I should be free then.
   (ii) I ought to be free then.
   (iii) I'll probably be free then.
   (iv) I must be free then.

If the conversation ends here, responses (24bi), (24bii), and (24biii) are all acceptable; by contrast, (24biv) is a strange way to end the conversation, and seems to require that some argument be given ('…my secretary always leaves my Thursdays open'). The prediction of the present account, then—that modals which are not *Pragmatically Strong*, like 'might/ought/should/probably', do not carry a *Support* constraint—thus seems correct.[23]

The present proposal makes a prediction which is worth highlighting: any construction which has the features which played a role in the present derivation is predicted to give rise to a *Support*-like constraint. That is, any construction which has φ as a structurally simpler relevant alternative; which has the same basic update effect as an assertion of φ; and which highlights the speakers' collective doxastic relation to $[\![\varphi]\!]$, is, *ceteris paribus*, predicted to give rise to *Support* (and thus also *Indirectness*). Further research should examine other expressions that share these three features to see if this prediction is borne out.[24]

[23] And the *Indirectness* inference for 'might/ought/should/probably' is easy to explain on pragmatic grounds without a detour through *Support*.

[24] $\ulcorner$It's agreed that $\varphi\urcorner$, $\ulcorner$Let's agree that $\varphi\urcorner$, $\ulcorner$We should believe $\varphi\urcorner$, and $\ulcorner$It is clear that $\varphi\urcorner$ all seem to have these properties, and do indeed appear to be governed by corollaries of *Support* and *Indirectness* (see Barker 2009 on the last of these). This suggests that, even if the pragmatic derivation I have given here is mistaken in some of its details, the explanation for both *Indirectness* and *Support* is pragmatic, and stems from the properties I have pointed to.

5. Conclusion

The argument of this paper has come in three parts. I began by arguing that, to fully characterize the differences in felicity conditions between an assertion of $\ulcorner$Must $\varphi\urcorner$ and an assertion of φ, we need not only *Indirectness* but also *Support*. Next, I argued that we can derive *Indirectness* from *Support* together with general pragmatic principles about assertions, and I argued that this derivation of *Indirectness* makes attractive predictions about when a 'must'-claim is unacceptable. Finally, I made a proposal about how to derive *Support* as a manner implicature from a certain semantics for epistemic modals which treats them as quantifiers over the set of worlds compatible with the common ground.

The three parts of this argument are, to a degree, independent. If each of these moves is successful, however, then taken together, they constitute a solution to Karttunen's Problem: characterizing and explaining the differences in felicity conditions between an assertion of $\ulcorner$Must $\varphi\urcorner$ and an assertion of φ. In short: because of its more complex form and the question it makes salient, $\ulcorner$Must $\varphi\urcorner$, unlike φ alone, requires that an argument be given for $[\![\varphi]\!]$; and from the requirement, in turn, we can conclude that the speaker's evidence for $[\![\varphi]\!]$ is relevantly indirect.

In conclusion, I highlight a few broad upshots of my approach to Karttunen's Problem. The first is about the relation between 'must' and evidentiality. I have argued that 'must' does not grammaticalize a certain constraint on the *type* of evidence, in any intuitive sense, which the speaker must have for its prejacent. Rather, the felt indirectness of 'must'-claims is accounted for pragmatically, and it is accounted for not directly in terms of judgments about type of evidence but rather in terms of judgments about *redundancy*.

The second is about the meaning of 'must'. My derivation of *Support* rests on a certain semantics for 'must'. If the derivation is successful, then it provides an argument for adopting that semantics, and presents a challenge for advocates of different semantics for 'must': to show how those approaches can explain *Support*.

The third regards the theory of redundancy. I have argued that the norms that governs redundancy in assertions play a crucial role in explaining our interpretation of modal language. My sketch of what those norms are like, however, leaves unanswered substantial questions, in particular about what counts as a 'mutually obvious' inference—questions which I hope to explore in future work. A theory of redundancy—in essence, a theory of how our minds structure and access information—will play a central role in understanding the way that information is structured in discourse, and judgments about 'must'-claims provide a rich source of data for this theory.

I close with an abstract point about the architecture of semantic and pragmatic theories. My proposal rests on the assumption that an assertion of $\ulcorner$Must $\varphi\urcorner$ and an assertion of φ have the same basic update effect, but different semantic values. Indeed, on the semantics I have sketched, $\ulcorner$Must $\varphi\urcorner$ and φ informationally entail one another—in the sense that a context updated with either one entails the other—but they do not semantically entail one another. The possibility of this divergence between update effect and meaning proved essential for simultaneously capturing the intuition that an update with ⌜Must φ⌝ is pragmatically strong, and the intuition that it cannot always be asserted where φ alone can be. Not everyone thinks that we should distinguish between semantic content and pragmatic update effect at all; in particular, at a high level, certain threads in dynamic semantics aims to identify these. If the present approach to Karttunen's Problem is the right one, however, then distinguishing semantic content from pragmatic update effect in our theorizing about natural language turns out to be crucial.

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Expletive negation and the decomposition of *only*[1]

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Abstract. This paper is focused on the seemingly superfluous sentential negation showing up in Hebrew *until*-clauses. I discuss a scalar implicature arising from *until*-clauses which surprisingly becomes uncancellable when this negation is present. I argue that this inference becomes obligatory due to the presence of an *only*-like exhaustivity operator, which gets (partially) spelled out as negation since it is composed of negation and an exceptive. Moreover, this negation is shown to share more properties with *only*.

Keywords: Expletive negation, exhaustification, scalar implicatures, *until*.

1. Introduction

A seemingly superfluous negation participates in a multitude of constructions, among which are certain temporal clauses. This paper is focused on the superfluous sentential negation showing up in Hebrew *until*-clauses.[2,3] I refer to sentential negation which does not make a straightforward contribution to meaning as EXPLETIVE NEGATION or EXN in short. The assumption that sentential negative morphemes are interpreted as negative operators is what makes EXN puzzling.[4]

In this paper I discuss a scalar implicature arising from *until*-clauses which surprisingly becomes uncancellable when EXN is present. I argue that this inference becomes obligatory due to the presence of an *only*-like exhaustivity operator, which gets (partially) spelled out as negation. According to the proposal put forward in the paper, negation is capable of realizing an *only*-like operator because such an operator is actually composed of negation and an exceptive, as has already been proposed for overt *only* in von Fintel and Iatridou (2007).

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[2]The phenomenon is also attested at least in Bangla (Ishani Guha, p.c.), French (Sophie Moracchini, p.c.), German (Krifka, 2010), Italian (Tovena, 1996), and Russian (Abels, 2005).

[3]Other occurrences of puzzling negation which will not be discussed in this paper include negative concord (Zeijlstra, 2004, 2008: among many others), preposed negation in biased polar questions (Ladd, 1981; Büring and Gunlogson, 2000; Romero and Han, 2004; Han and Romero, 2004), rhetorical and tag questions, exclamatives (Portner and Zanuttini, 2000), complements of certain attitude predicates (Abels, 2005; Yoon, 2012; Makri, 2015), comparatives, and complements of *almost* (Kaufmann and Xu, 2013).

[4]The puzzle remains as long as one assumes a correspondence between the negative morpheme and an interpreted negative operator. In the simple case the negative morpheme itself carries the negative semantics. A sentential negative morpheme could also give rise to an interpreted negative operator when it is in a dependency with an abstract negation, as in Zeijlstra's (2004; 2008) work on negative concord. In both cases, a superfluous negative morpheme is perplexing.

Such an analysis predicts that ExN and *only* should share more properties. I show that this prediction is borne out: ExN is odd when there are no alternatives to exclude, it is incompatible with overt *only* and with downward entailing (DE) environments, it triggers optional stress and preposing of the *until*-clause, and cannot license negative concord.

The paper is structured as follows: §2 presents the data on ExN and its interpretive effect. §3 consists of the analysis in which *only* is decomposed into negation and an exceptive, and shows how it can capture the semantics and syntax of ExN. §4 discusses further predictions of the proposal and shows that they are borne out. §5 concludes and briefly mentions questions that are left open.

2. Data

2.1. ExN in *until*-clauses

A Hebrew *until*-clause can host the sentential negation *lo*, superficially without affecting interpretation, as demonstrated by the following examples.[5]

(1) *adam hu xaf mi-peʃa ad Se (**lo**) huxexa aʃmat-o*
man he free from-crime until that NEG was proven guilt-his
'A man is innocent until proven guilty.'

(2) *ze lo nigmar ad ʃe ze (**lo**) nigmar*
it NEG finished until that it NEG finished
'It ain't over till it's over.'

(3) *joni jaʃan ad ʃe ha-ʃxenim (**lo**) hidliku muzika*
Y. slept until that the-neighbors NEG lit music
'Yoni was asleep until the neighbors turned some music on.'

(4) *ha-ʃvita timaʃex ad ʃe (**lo**) jeʔanu driʃot ha-ovdim*
the-strike will continue until that NEG will be answered demands the-workers
'The strike will continue until the workers' demands are met.'

(5) *miri lo nirdemet ad ʃe (**lo**) korʔim l-a sipur*
M. NEG falls asleep until that NEG read.PL to-her story
'Miri doesn't fall asleep until you read her a story.'

Note that (1)–(5) can in principle have an additional reading in which negation is interpreted as usual. For example, (1) can have the (odd) reading 'A man is innocent until *not* proven guilty'.[6]

[5] Examples (1) and (3) are modified versions of Eilam's (2007) examples (3) and (5).
[6] As Eilam (2007) observed, this reading is the only one available if the negative morpheme *lo* is stressed.

2.2. The Interruption Implication

2.2.1. Optional interruption without ExN

In this subsection I discuss English examples, but it should be noted that the facts are the same for Hebrew *until*-clauses when they do not contain ExN. The next subsection contains discussion of Hebrew ExN cases.

Sentences containing *until* generally give rise to an inference – which I call THE INTERRUPTION IMPLICATION – according to which the matrix eventuality came to an end upon the onset time of the *until*-phrase/clause. From (6) for example, one infers that Mary stopped playing the piano at five or at the time of John's opening the door.

(6) Mary played the piano until five / until John opened the door.
$\rightsquigarrow$ $\neg$[Mary played the piano after five / after John opened the door].

The interruption implication has two properties of a scalar implicature: (i) it is cancellable, and (ii) it does not arise when the *until*-clause is embedded in a downward-entailing environment. None of (7a)–(7d) gives rise to the interruption implication.

(7) **In all the following $\not\rightsquigarrow$ $\neg$[Mary played the piano after John opened the door]:**
a. Mary played the piano until John opened the door. *Moreover*, she was still playing the piano (when and) after he opened it.
b. Mary played the piano until John opened the door *and perhaps even afterwards*.
c. Mary played the piano *at least* until John opened the door.
d. Q: Is Mary still playing the piano?
A: *Well, I'm not sure but* (what I know is that) she definitely played the piano until John opened the door.

Scalar implicatures are known to disappear in downward-entailing environments. Compare (8a) to (8b), which embeds a minimally modified version of (8a) in the restrictor of a universal quantifier, a downward-entailing environment. If the *not all* inference in (8a) were part of the meaning of *some*, we should expect (8b) to quantify over students who did *only some* of the reading. However, it follows from (8b) that students who did all of the reading got an A just like those who did some but not all of it.

(8) a. Mary did some of the reading.
$\leftrightsquigarrow$ Mary did **only** some of the reading. (= M. did some but not all of it.)
b. Every student who did some of the reading got an A.
$\not\leftrightsquigarrow$ Every student who did **only** some of the reading got an A.

Similarly, the interruption implication in (9a) is not preserved in (9b). Those students who played the piano not only until John opened the door, but even until some later time, are entitled to a prize to no lesser degree than those who played the piano only until John opened the door. This is a reason not take the interruption implication to be part of the lexical semantics of *until*.

(9) a. Mary played the piano until John opened the door.
$\leftrightsquigarrow$ Mary played the piano **only** until John opened the door (*and no later*).
b. Every student who played the piano until John opened the door will get a prize.
$\not\leftrightsquigarrow$ Every student who played the piano **only** until opened the door (*and no later*) will get a prize.

The cancellability of the interruption implication and its disappearance in downward entailing environments puts it in the same group of inferences as scalar implicatures. Now let us see how EXN affects the availability of the interruption implication.

2.2.2. Obligatory interruption with EXN

The facts are the same for Hebrew *until*-clauses, but only without EXN. EXN makes the interruption implication obligatory: it cannot be cancelled nor can an *until*-clause containing EXN be embedded in a downward-entailing environment.

(10) *joni jaʃan le-faxot ad ʃe azavti*
Y. slept to-less until that 1.left
'Yoni slept at least until I left.'

(11) **joni jaʃan le-faxot ad ʃe* ***lo*** *azavti*
Y. slept to-less until that NEG 1.left (cf. (10) and (7c))

(12) *joni jaʃan ad ʃe* ***lo*** *azavti, #ve-ulaj afilu ad zman meʔuxar joter*
Y. slept until that NEG 1.left, and-maybe even until time late more
'Yoni slept until I left #and perhaps even until some later time.' (cf. (7b))

Example (13a), but not (13b), can be used in the exchange in (14), which requires at least partial ignorance regarding Yoni's awakening time (cf. (7d)).

(13) a. *joni jaʃan ad ʃe azavti*
Y. slept until that 1.left
'Yoni was asleep until I left.'

b. *joni jaʃan ad ʃe* ***lo*** *azavti*
Y. slept until that NEG 1.left
'Yoni was asleep until I left.'

(14) Q: Is Yoni still asleep?
A: Well, I'm not sure but (13a).
A': #Well, I'm not sure but (13b).

In the previous section we have seen scalar implicatures disappear in downward-entailing (DE) environments. Later I will propose that EXN is related to a grammatical mechanism generally responsible for scalar implicatures. If they disappear in DE environments because this mechanism cannot take place in such environments, we expect a clash between DE environments and EXN.

Consistent with the obligatoriness of the interruption implication with EXN, an *until*-clause containing EXN cannot be embedded in a DE environment such as the restrictor of a universal quantifier (15b) or the antecedent of a conditional (16b). Examples (15c) and (16c) show that EXN is allowed in related upward-entailing environments: the restrictor of *one* and the consequent of a conditional.

(15) a. *kol mitmoded ʃe jaʔatsor et ha-neʃima ad ʃe ha-paamon*
every contestant that 3.stop.FUT ACC the-breath until that the-bell
jetsaltsel jekabel pras
3.ring.FUT 3.receive.FUT prize
'Every contestant who holds their breath until the bell rings will get a prize.'

b. ??*kol mitmoded ʃe jaʔatsor et ha-neʃima ad ʃe ha-paamon* ***lo***
every contestant that 3.stop.FUT ACC the-breath until that the-bell NEG
jetsaltsel jekabel pras (nixumim)
3.ring.FUT 3.receive.FUT prize (consolations)
'Every contestant who holds their breath until the bell rings will get a (consolation) prize.'

c. *mitmoded exad ʃe jaʔatsor et ha-neʃima ad ʃe ha-paamon* ***lo***
contestant one that 3.stop.FUT ACC the-breath until that the-bell NEG
jetsaltsel jekabel pras
3.ring.FUT 3.receive.FUT prize
'One contestant who holds their breath until the bell rings will get a prize.'

(16) a. *im miri taʔatsor et ha-neʃima ad ʃe ha-paamon jetsaltsel, hi*
if M. 3.stop.FUT ACC the-breath until that the-bell 3.ring.FUT she
tekabel pras
3.receive.FUT prize
'If Miri holds her breath until the bell rings, she will get a prize.'

b. ??*im miri taʔatsor et ha-neʃima ad ʃe ha-paamon* ***lo*** *jetsaltsel, hi*
if M. 3.stop.FUT ACC the-breath until that the-bell NEG 3.ring.FUT she
tekabel pras
3.receive.FUT prize
'If Miri holds her breath until the bell rings, she will get a prize.'

c. *im miri rotsa le-kabel pras, hi taʔatsor et ha-neʃima ad ʃe*
if M. wants to-receive prize, she 3.stop.FUT ACC the-breath until that
ha-paamon ***lo*** *jetsaltsel*
the-bell NEG 3.ring.FUT
'If Miri wants to get a prize, she will hold her breath until the bell rings.'

To summarize the data in this section, the interruption implication, an otherwise optional scalar implicature, becomes obligatory with EXN. Moreover, EXN cannot be embedded in DE environments.

3. Analysis

3.1. The core of the proposal: *only*

An intuition which can provide insight into the contribution of ExN is that adding ExN to an *until*-clause parallels the addition of *only*: *Mary played until John* **ExN** *opened the door* ≈ *Mary played* **only** *until John opened the door*. Fleshing out this intuition will get us closer to an LF and allow us to predict the obligatoriness of the interruption implication with ExN.

(17) **Hypothesis**: *until*-clauses hosting ExN contain an *only*-like exclusive particle.

If an *only*-like exclusive particle is involved, we need to determine the set of alternatives it operates on. Suppose that φ *until t* has the set of alternatives in (18), for any t_-, t, t_+ such that $t_- < t < t_+$:

(18) $Alt(\varphi \ until \ t) = \{\ldots, \varphi \ until \ t_-, \varphi \ until \ t, \varphi \ until \ t_+, \ldots\}$

That is, the alternatives of φ *until t* differ from it only in the time until which φ holds. This way we can generate a set of alternatives that exhausts the entire (contextually restricted) temporal domain.[7] Crucially, this set of alternatives is ordered by entailment, as shown in (19). For example, φ *until five* asymmetrically (Strawson-)entails that φ *until four*.

(19) $(\lambda w. \varphi \ until \ t_+ \ in \ w) \subset (\lambda w. \varphi \ until \ t \ in \ w) \subset (\lambda w. \varphi \ until \ t_- \ in \ w)$

To see that the hypothesis in (17) makes the correct predictions, let us assume for now that (20) holds. In the next section I modify (20) and explicate the affinity between ExN and *only*.

(20) **Assumption (to be modified)**: ExN is semantically vacuous but triggers obligatory strengthening in the sense of Fox (2007); Chierchia et al. (2012); Chierchia (2013).

That is, ExN requires the alternatives of the clause in which it occurs to not be ignored but be taken into consideration by an exhaustivity operator. Such an operator is a covert counterpart of *only*, a simplified version of which is defined in (21). EXHAUST asserts the truth of its prejacent and the falsity of any alternative which is not entailed by the prejacent.[8] Assuming for simplicity that the only alternatives are the ones in (18), strengthening results as in (22).

(21) $[\![\text{EXHAUST}]\!] = \lambda A_{st,t}.\lambda p_{st}.\lambda w_s.\, p(w) = 1 \wedge \forall q \in A\,[(p \not\subseteq q) \rightarrow q(w) = 0] \quad \approx [\![Only]\!]$

(22) $[\![\text{EXHAUST}(Alt)(\varphi \ until \ t)]\!]^w = 1$ iff φ *until t in w* $\wedge$ for any $t_+ > t, \neg[\varphi \ until \ t_+]$ *in w*

[7] I am assuming that *until*'s complement has to denote a time, either inherently ('until five') or by definitizing a temporal property ('until John opened the door'). For more details see §3.3.1.

[8] The denotation in (21) omits Fox's (2007) qualification that the excluded alternatives be INNOCENTLY EXCLUDABLE. This is so since in the case of (18), the alternatives are already totally ordered, and in particular all non-weaker alternatives are innocently excludable.

This is so because both φ *until t* and φ *until* t_- are entailed by φ *until t*, but φ *until* t_+ is not. Thus, φ *until t* ends up meaning φ *until t* ***and no later than t***, giving us the interruption implication.[9]

Moreover, the incompatibility of ExN with DE-environments (§2.2.2) is predicted by the analysis when taken together with any grammatical theory of scalar implicatures which explains their disappearance in such environments by lack of exhaustification. In other words, since I propose to relate ExN with EXHAUST, all that is needed to predict ExN's incompatibility with DE-environments is a reason for EXHAUST to be incompatible with such environments. Since such incompatibility is in fact attested, I submit that once we have an explanation for this phenomenon the incompatibility of ExN with DE-environments would be predicted without further stipulations.[10]

3.2. Decomposing *only*

Why should the assumption in (20) hold? It would be peculiar for a negative morpheme to be ambiguous between actual negation and ExN, especially across so many languages (see fn. 2). So how should one think of the association between ExN and *only*?

If one entertains the possibility that EXHAUST is syntactically complex, containing a negative piece, one could better understand ExN as a plain compositional negation.

(23) **Revised hypothesis**
a. *Until*-clauses hosting ExN contain an *only*-like operator. (= (17))
b. The negative morpheme is a reflex of a negative component of that operator.

3.2.1. Sufficiency Modal Constructions

One decomposition of *only* is proposed by von Fintel and Iatridou (2007), who discuss SUFFICIENCY MODAL CONSTRUCTIONS such as in (24):

(24) To get good cheese, you only have to go to the North End.

They observe that crosslinguistically, one also finds a second pattern: *To get good cheese, you*

[9] For convenience I will continue referring to the interruption implication as a scalar implicature, even though under the grammatical view adopted here scalar implicatures are analysed as entailments.

[10] It should be noted that unlike EXHAUST and ExN, overt *only* is allowed in DE environments:

(i) If the rhino eats only artichokes, it might be sick.
(ii) Every rhino who ate only artichokes was examined by the vet.

Additionally, the prejacent is treated differently by the two operators: EXHAUST asserts it, while *only* presupposes it. An idea suggested to me by Danny Fox (p.c.) would be that while *only* and EXHAUST are built of the same parts, EXHAUST involves local accommodation, thus turning the presupposed prejacent into an asserted one.

do ***not*** *have* ***but*** *go to the North End.* The following are two examples adapted from von Fintel and Iatridou's (2)–(3):

(25) . . . ***dhen*** *echis* ***para*** *na pas sto North End*
NEG have.2SG EXCEPT NA go.2SG to.the North End
'. . . you only have to go to the North End' (Greek)

(26) . . . *tu* ***n'****as* ***qu'****à aller au North End*
you NE-have QUE-to go to.the North End
'. . . you only have to go to the North End' (French)

Another observation made by von Fintel and Iatridou is that for a (goal-oriented necessity) modal to be able to participate in a sufficiency modal construction, it has to be a non-PPI modal. That is, it has to be able to scope under negation.

Von Fintel and Iatridou propose to treat *only* crosslinguistically – even in languages where there are no overt negation-and-exceptive sufficiency constructions – as composed of a negation and an exceptive. Together with the assumption that the exceptive is (or hosts) an NPI, they allow the modal to take scope between the two components:

(27) To get good cheese, you do ***not*** have to do ***anything other than*** going to the N. End.

3.3. Proposal: EXN is an exponent of *only*

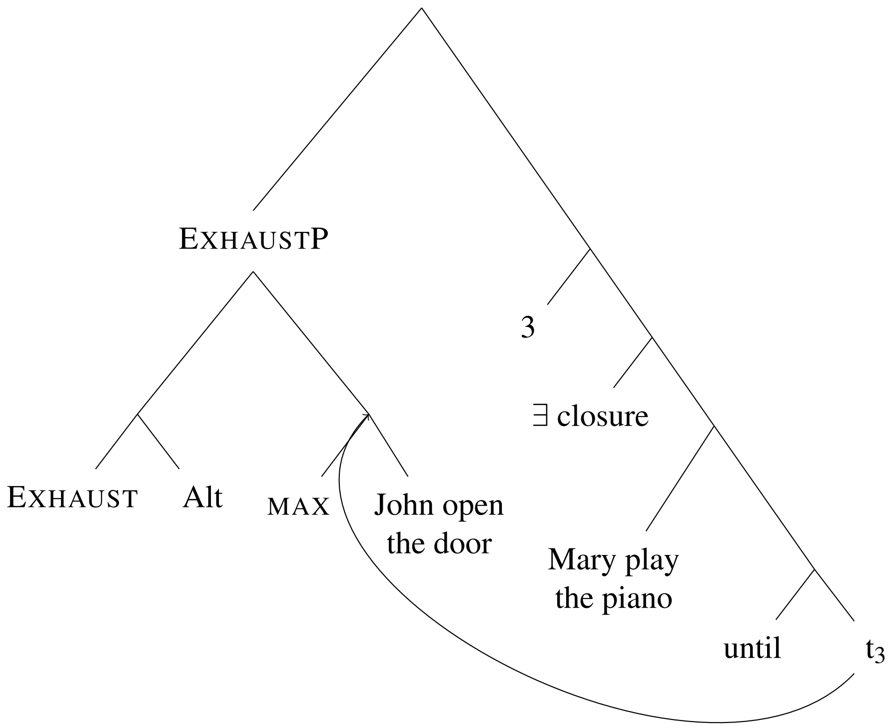
To briefly sum up, the data involves a negative morpheme along with an obligatory interruption implication, which I submit results from an *only*-like exhaustivity operator (§3.1). The decomposition of *only* into a negative part and an exceptive part as proposed by von Fintel and Iatridou (2007) paves the way to understanding EXN as a regular compositional negation: if EXN is the negative component of the exhaustivity operator, as I propose, we can predict the data while maintaining a single meaning for the negative morpheme. To achieve this I will assume that both pieces are syntactically present: negation is overt, while the exceptive is covert.

A sentence of the form *A until* EXN *B* is thus paraphrasable as *A until not anything other than B*. As before, assuming that what *anything other than* ranges over is times (18), we would not be able to exclude any earlier time due to entailment, but *would* be able (and required) to exclude later times, thus predicting the interruption implication. In the following two sections I go through the details of the proposal.

3.3.1. Assumptions

The following structure is what I take to be the LF for *Mary played the piano until John* EXN *opened the door*. I return to the decomposition of EXHAUSTP after discussing my assumptions below.

(28)



The movement step in (28) is a case of Focus-movement, a kind of sideways movement discussed in Wagner (2007) and Erlewine and Kotek (2017), among others. The associate of the focus-sensitive operator EXHAUST moves to it, as the associate of *only* would in Wagner's (2007) analysis.

I will assume that clauses denote temporal properties (i.e., characteristic functions of sets of time intervals).[11] I follow Condoravdi (2010) in: (i) taking *until* to uniformly compose with a time, even when its surface complement is a clause, and (ii) assuming that a maximality operator MAX (i.e., a definite determiner of type $\langle it, i\rangle$) applies to *until*'s clausal complement to yield the desired time argument: the (smallest) maximal interval instantiating the complement.

Until will be analyzed as denoting a relation between times: $[\![until]\!] \in D_{\langle i,it\rangle}$. It composes with its first argument, be it a time-denoting DP or a clause, resulting in a temporal property (i.e., of type $\langle i,t\rangle$). This temporal property then composes intersectively (i.e., by Predicate Modification) with the matrix clause.

To capture the entailment that the main clause was true at *all* times up to the time of the *until*-phrase, I take it that *until*'s quantificational force is universal. Just like other quantifiers, *until* has a contextually restricted domain (von Fintel, 1994). The domain of time intervals D_i is contextually restricted to its subset C_i. This would prevent *Mary played the piano until five* from entailing that she played the piano since the beginning of time.

[11]These functions of type $\langle i,t\rangle$ could in principle be extended to other kinds of intensions in various ways (e.g., by assuming that type s is of world-time pairs and that clauses are of type $\langle s,t\rangle$, or that clauses are of type $\langle i,st\rangle$ or $\langle s,it\rangle$). Since this extension is immaterial to the analysis, I ignore worlds altogether.

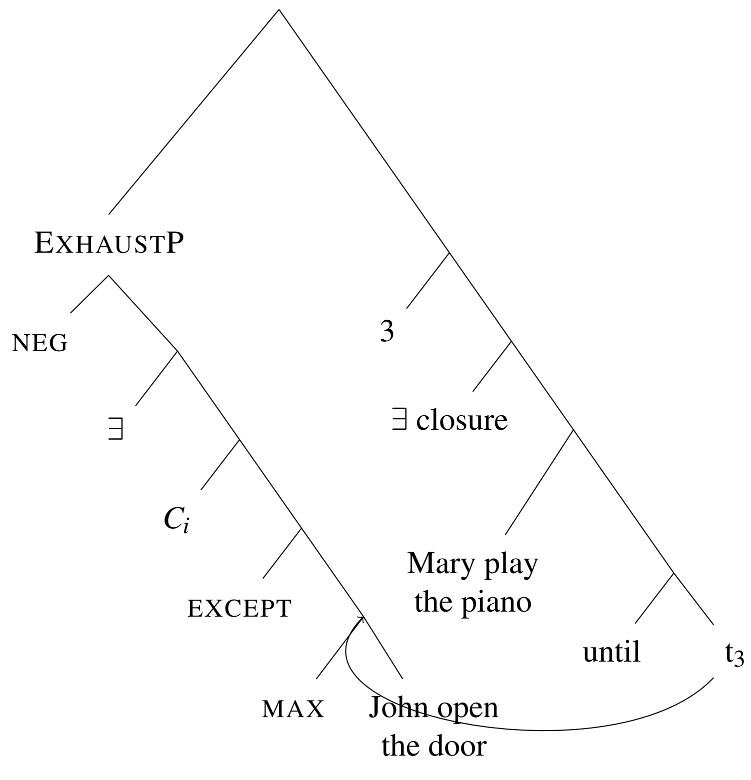
Alternatives are derived by substituting *until*'s complement with other times in C_i. Thanks to keeping C_i constant, *until 5* ends up asymmetrically (Strawson-)entailing *until 4* (as far as Strawson-entailment is concerned, this is a variant of Condoravdi, 2010).

I implement von Fintel and Iatridou's (2007) view of the exceptive phrase as being an NPI and having existential force by taking the exceptive phrase to contain, in addition to the exceptive head, an existential quantifier restricted to a contextually salient domain. In the relevant cases the domain is the contextually restricted temporal domain C_i. Given these assumptions, the decomposition of EXHAUSTP in (28) is as follows:

(29) NEG [∃ [C_i [EXCEPT [MAX [John open the door]]]]]

Note that there is a tension between the semantics and the surface syntax regarding the position of negation. For interpretation, we need it scoping as high as possible to negate not only the *until*-clause but also the matrix clause. On the other hand, negation shows up inside the *until*-clause in the surface string (see more on this in §3.3.3). To allow a suitable configuration, I will assume the following structure, with a negation of type $\langle itt, itt \rangle$.[12,13]

(30)



[12] Other cases of high-type negation include determiner negation such as *no NP*, *not every NP*, as well as the ones in *impossible* and *unhappy*.

[13] The semantics is compatible with negation occupying a lower position, adjoined to the the existential quantifier in (29), or a higher position, c-commanding both the matrix clause and the *until*-clause. The former would be similar to determiner negation in fn. 12, while the latter would be plain propositional negation. The proposal ends up not taking either of these paths due to the surface position of negation, as discussed in §3.3.3.

3.3.2. Denotations and calculations

Below I specify the denotations of the components and their composition. The discussion considers nominal complements as well as clausal complements of *until*.

(31) $[\![\text{P}]\!] := [\![\text{Mary played the piano}]\!] = \lambda t_i.$ Mary play the piano at t

(32) a. $[\![\text{until}]\!] = \lambda t'_i.\lambda t''_i.\forall t \in C_i\,[(t < t') \rightarrow (t \subseteq t'')]$. In words, *until* relates two times, returning truth iff all times preceding the first are contained within the second.

b. $[\![\text{until five}]\!] = \lambda t''_i.\forall t \in C_i\,[(t < 5pm) \rightarrow (t \subseteq t'')]$. That is, the (characteristic function of the) set in C_i of all times which contain all times preceding *5pm*.

(33) Entailment between alternatives (cf. (19)):
$\lambda t''_i.\forall t \in C_i\,[(t < 5pm) \rightarrow (t \subseteq t'')] \quad \subset \quad \lambda t''_i.\forall t \in C_i\,[(t < 4pm) \rightarrow (t \subseteq t'')]$
That is, the set of times containing everything in C_i which precedes *5pm* is a proper subset of the set containing everything in C_i preceding *4pm*. This is so because if all times up to five are in an interval, then all times up to four are also in that interval, so any interval in the former set will be in the latter set. The latter set additionally contains at least an interval whose right edge is four, which is not a member of the former set. Thus we have captured the downward entailment property of *until*.

(34) Without interruption: $[\![\text{P until five}]\!] = \lambda t_i.\,[\![\text{P}]\!]\,(t) = 1 \wedge \forall t' \in C_i\,[(t' < 5pm) \rightarrow (t' \subseteq t)]$
That is, the (characteristic function of the) set in C_i of all times at which Mary played the piano and which also contain all times prior to five.[14]

(35) a. $[\![\text{O}]\!] := [\![\text{John opened the door}]\!] = \lambda t_i.$ John open the door at t

b. $[\![\text{Mary played the piano until John opened the door}]\!] = [\![\text{P [until [}\textsc{max}\text{ [O]]]}]\!]$

c. $t_{O_j} := [\![\textsc{max}[O]]\!] =$ the smallest t s.t. $\forall t'[[\![\text{O}]\!](t') = 1 \rightarrow t' \subseteq t]$, if defined

d. $[\![until\,[\textsc{max}\,(O)]]\!] = \lambda t''_i.\forall t \in C_i[(t < t_{O_j} \rightarrow (t \subseteq t'')]$
That is, the (characteristic function of the) set of all times which contain all times in C_i preceding John's door-opening.

(36) **Without interruption**:
$[\![\text{P until }\textsc{max}\text{ O}]\!] = \lambda t''_i.\,[\![\text{P}]\!]\,(t'') = 1 \wedge \forall t \in C_i\left[t < t_{O_j} \rightarrow (t \subseteq t'')\right]$
That is, the (characteristic function of the) set in C_i of all times at which Mary played the piano and which also contain all times prior to John's door-opening.

(37) **With interruption**:
$[\![(30)]\!] = 1$ iff $\neg\exists t'' \in C_i[t'' \neq t_{O_j} \wedge \exists t'[[\![P]\!](t') = 1 \wedge \forall t \in C_i[t < t'' \rightarrow t \subseteq t']]]$
That is, (30) is true iff there doesn't exist a time other than John's door-opening time until which Mary plays the piano.

[14]I am assuming that existential closure applies later and eliminates the final lambda-binder.

3.3.3. Linearization

In the Hebrew examples in §2, EXN appears on T(ense) of the embedded *until*-clause, whereas the analysis locates the negation responsible for it in the main clause. What can explain this?

It is important to note that even non-expletive occurrences of *lo* raise a linearization question, if we follow Zeijlstra (2004, 2008) in assuming that abstract negation is the semantic negation in strict negative concord languages such as Hebrew. I propose a PF rule for Hebrew negation which captures both EXN and other ('ordinary') occurrences of Hebrew negation:

(38) An (abstract) negation NEG is spelled out as *lo* on the closest T it c-commands.

This predicts both the distribution of ordinary negation and that of EXN, if we take NEG, as part of EXHAUST, to be locally above the *until*-clause. This will put it high enough for the embedded T to bear agreement, but too low for the matrix T. Exactly this kind of configuration is predicted by the LF in (30) because the complement of *until*, including its T head, moves to EXHAUST.[15]

4. Predictions

We have seen how the idea that EXN is an exponent of *only* predicts the obligatoriness of the interruption implication and the incompatibility of EXN with DE-environments. Furthermore, the current analysis predicts EXN to share more properties with *only*. This prediction is borne out in (i) EXN's oddness when there are no alternatives to exclude, (ii) its incompatibility with overt *only*, (iii) its ability to trigger stressing and preposing of the *until*-clause, and (iv) the lack of negative concord licensing by EXN. I examine these predictions below.

4.1. #EXN when there are no alternatives to exclude

World knowledge makes (39b) odd, while felicitous without EXN. This is so because the prejacent is stronger than all other alternatives, rendering EXN – and *only* in the English translation – vacuous.[16]

(39) a. *ani ohav ot-ax ad ʃe jigamer ha-zman / jitpotsets ha-olam*
I love.FUT ACC-you until that end.FUT the-time / explode.FUT the-world
'I will love you until the end of time / until the world explodes.'

b. #*ani ohav ot-ax ad ʃe* ***lo*** *jigamer ha-zman / jitpotsets ha-olam*
I love.FUT ACC-you until that NEG end.FUT the-time / explode.FUT the-world
'#I will love you **only** until the end of time / **only** until the world explodes.'

[15] Michel DeGraff (p.c.) suggests another way to capture the surface position of negation while allowing it to take wide scope: movement. Negation would have to start inside the *until*-clause, where it is pronounced, and move out of it at LF to take matrix scope. This seems to be in line with the observation that EXN tends to be accompanied by subjunctive mood in the *until*-clause in various languages.

[16] Just as in the English translation, (39b)'s oddness can be ameliorated by taking the speaker to have some alternatives (i.e., later times) in mind. This supports the claim that there must be some alternatives to exclude.

4.2. ExN is incompatible with overt *only*

Just like adding *only* to an existing *only* is ungrammatical, arguably because the second *only* would be vacuous, ExN cannot be accompanied by an overt *only* with the same associate:[17,18]

(40) a. **joni jaʃan rak ad ʃe ha-ʃxenim* ***lo*** *hidliku muzika*
Y. slept only until that the-neighbors NEG lit music
b. *joni jaʃan rak ad ʃe ha-ʃxenim hidliku muzika*
Y. slept only until that the-neighbors lit music
'Yoni was asleep only until the neighbors turned some music on.'

4.3. Preposing and stress

The relevant background on Hebrew is that contrastive focus can cause preposing of the focused phrase, as illustrated below. Both (42a) and (42b) are licit corrections to (41).[19]

(41) *hu axal tapuax-adama*
he ate apple-earth
'He ate a potato.'

(42) a. ARTIʃOK *hu axal*
artichoke he ate
'He ate an ARTICHOKE.'

b. *hu axal* ARTIʃOK
he ate artichoke
'He ate an ARTICHOKE.'

Many of the speakers I have consulted prefer (some require) preposing the *until*-clause when it contains ExN and stressing *ad* 'until'.[20] For example, take (4), repeated here as (43a). Its version (43b), with preposing of the *until*-clause and stress on *until* is judged by the informants I have consulted as preferable compared to (43a) if ExN is present.

(43) a. *ha-ʃvita timaʃex ad ʃe (**lo**) jeanu driʃot ha-ovdim*
the-strike will continue until that NEG will be answered demands the-workers
'The strike will continue until the workers' demands are met.'
b. A:D *ʃe (**lo**) jeanu driʃot ha-ovdim ha-ʃvita timaʃex*
until that NEG will be answered demands the-workers the-strike will continue
'UNTIL the workers' demands are met the strike will continue.'

[17] As long as ExN has sentential scope, an overt *only* with narrow focus is allowed, for example, associating with a DP.

[18] (40a) is grammatical – though odd – under a non-expletive interpretation of negation.

[19] Cf. English negative inversion, where association with focus causes optional overt movement:

(i) Only in the living room did Kim agree to hang the photo.

[20] Rubinstein and Doron (2015) make a similar observation regarding ExN and stress in constituent unconditionals, which is placed on a *wh*-item.

Stress and preposing, two hallmarks of association with focus, would be better understood if EXN were, as I propose here, a component of a focus-sensitive operator. Those speakers who require stress and preposing must have obligatory overt focus-movement.

4.4. No negative concord with EXN

As noted in §2, negation in *until*-clauses can in principle also have an 'ordinary' negative interpretation. When a Negative Concord Item (NCI, a.k.a. *n-word*) is c-commanded by the negation *lo*, this becomes the only available interpretation. In other words, EXN cannot license negative concord.[21] In both (44) and (45) the first example contains the negation *lo* and has both interpretations available, whereas the second example contains a NCI replacing the embedded subject and causing *lo* to not be expletive.

(44) a. *ha-saxkan himʃix b-a-stsena ad ʃe joni (**lo**) baxa*
the-actor continued in-the-scene until that Y. NEG cried
–'The actor continued with the scene until Yoni cried.'
–'The actor continued with the scene until Yoni was no longer crying.'
b. *ha-saxkan himʃix b-a-stsena ad Se **af** exad **lo** baxa (joter)*
the-actor continued in-the-scene until that no one NEG cried (more)
Only: 'The actor continued with the scene until nobody was crying (anymore).'
(Not: 'The actor continued with the scene until somebody cried.')

(45) a. *miri amda al ha-bama ad ʃe joni (**lo**) maxa kapaim*
M. stood on the-stage until that Y. NEG clapped palms
–'Miri stood on the stage until Yoni applauded.'
–'Miri stood on the stage until Yoni did not applaud (anymore).'
b. *miri amda al ha-bama ad ʃe **af** exad **lo** maxa kapaim (joter)*
M. stood on the-stage until that no one NEG clapped palms (more)
Only: 'Miri stood on the stage until nobody was applauding (anymore).'
(Not: 'Miri stood on the stage until somebody applauded.')

Lack of negative concord under EXN follows from the independent generalization that exceptives are intervenors for negative concord, as (46) demonstrates. If EXN comes with a covert excpetive, as proposed here, negative concord is predicted not to be licensed. The only available reading in (44b) and (45b) arises from the need to parse these sentences without an exceptive, which would otherwise block negative concord.

[21] One might wonder whether NPIs are licensed by EXN. Modulo the archaic flavor of NPIs in Modern Hebrew, (i) in fact shows that the NPI *davar* 'a thing' cannot be licensed by EXN, similarly to NCIs in (44) and (45) above. I thank Luka Crnič for raising this question.

(i) *servu le-ʃaxrer-o mi-maʔatsar-minhali ad ʃe **lo** axal davar*
3.refused.PL to-release-him from-arrest-administrative until that NEG 3.ate.SG thing
Only: 'They refused to release him from administrative detention until he did not eat anything (=until he went on a hunger strike).'
(Not: 'They refused to release him from administrative detention until he ate something.')

(46) a. *miri* ***lo*** *ra'ata* ***af*** *exad*
M. NEG saw no one
'Miri didn't see anybody.'
b. **miri* ***lo*** *ra'ata* ***ela af*** *exad*
M. NEG saw but no one
c. **miri* ***lo*** *ra'ata* ***milvad af*** *exad*
M. NEG saw except no one

5. Conclusion

5.1. Summary

We have seen that expletive negation suspiciously mimics *only* and its covert counterpart EXHAUST: (i) It renders the interruption implication, which is an otherwise optional scalar implicature, uncancellable; (ii) EXN is incompatible with DE environments just like EXHAUST is; (iii) EXN is odd if there are no alternatives to exclude; (iv) It is incompatible with overt *only*; (v) It triggers optional stress on *until* and preposing of the *until*-clause, both of which are hallmarks of association with focus, and (vi) EXN cannot license negative concord.

I have proposed that EXN is in fact an ordinary compositional negation, being part of a negation-and-exceptive construction responsible for all the *only*-like phenomena, whereas the exceptive is covert. This follows von Fintel and Iatridou's (2007) proposal to decompose overt *only* into a negation and an exceptive.

The analysis predicts the obligatoriness of the interruption implication as an entailment of the decomposed *only*. EXN's incompatibility with DE environments results from an independent property of covert *only*, observable when scalar implicatures disappear in such environments. The vacuity of EXN when there are no alternatives to exclude or when there is a distinct, overt *only* explains why EXN is odd in such cases. Preposing and stress associated with EXN are compatible with EXN being part of a focus-sensitive operator, and EXN's incapability to license negative concord is expected since exceptives block negative concord.

The crosslinguistic picture arising from this proposal is one where a negation-and-exceptive construction can be pronounced as a single item (e.g., English *only*), as two items (e.g., French *ne... que*), as an overt negation with a covert exceptive (EXN), as an overt exceptive with a covert negation (e.g., archaic English *but* as in *the building had but a single window*), or not pronounced at all (EXHAUST).

5.2. Next steps

There are multiple questions pertaining to EXN and to the specific proposal advanced in this paper which are left unanswered:

1. **Covert exceptives** What governs the pronunciation of exceptive heads? That is, when can an exceptive be covert? This is needed to prevent all occurrences of *only* and of EXHAUST from being expressible as negation.

2. **Punctual *until*** Can the analysis be extended to punctual *until* in examples like (47), where an interruption-like inference is obligatory?[22]

   (47) The dog didn't bark until Kim sneezed. (⇝ The dog barked when Kim sneezed)

3. **Causality** EXN has an interpretive effect which is additional to the interruption implication and is not predicted by what I have proposed in this paper. *Until*-clauses containing EXN are felt to convey causality of sorts, as though the eventuality described by the *until*-clause *leads to* the interruption of the eventuality described by the main clause in a non-coincidental way.[23]

4. **Free Relatives** A question related to questions 1 and 3 above pertains to EXN in Free Relative clauses, as attested in Hebrew, Yiddish, Russian, Polish, Udmurt, Georgian (Eilam, 2007; Rubinstein and Doron, 2015; Rubinstein et al., 2015; Haspelmath and König, 1998), and Bangla (Ishani Guha, p.c.). As Eilam (2007) shows, the contribution of EXN in such cases is reminiscent of that of *-ever* in English Free Relatives, along with ignorance and indifference inferences. It is not clear that an exclusive inference parallel to the interruption implication is present in such cases. At the same time, a source of hope for a unified account comes from the observation that some Free Relatives can host an overt *only*, as illustrated in (48).[24]

   (48) a. *ha-kelev jaʔakov axarej-xa le-ʔan ʃe-**rak** telex*
   the-dog 3MSG.follow.FUT after-2MSG to-where that-only go.2MSG
   'The dog will follow you wherever you go.'

[22]I thank Maribel Romero for raising this question.

[23] A related phenomenon, which to the best of my knowledge was not mentioned before, is the unavailability of *de re* readings with EXN. The EXN-less sentence in (i) can be true even if Miri is willing to be here until some time, say noon, and unbeknownst to her, Yoni is going to return at noon. When EXN is added in (ii) it can only be the case that Miri is willingly waiting for Yoni. In other words, in (i) she is willing to be here until some time that the *speaker* describes as Yoni's return time, but in (ii) she is willing to be here until some time that *she* describes as Yoni's return time.

(i) *miri muxana li-hiyot po ad Se yoni yaxzor*
M. ready to-be here until that Y. return.FUT
'Miri is willing to be here until Yoni returns.' (✓*de re*; ✓*de dicto*)

(ii) *miri muxana li-hiyot po ad Se yoni **lo** yaxzor*
M. ready to-be here until that Y. NEG return.FUT
'Miri is willing to be here until Yoni returns.' (**de re*; ✓*de dicto*)

[24]Another telling observation is that similarly to the facts on *until* in fn. 23, Free Relatives hosting EXN are obligatorily read *de dicto*. That is, they are of the *wh-ever* kind, with ignorance and indifference inferences, and not plain extensional definite descriptions.

b. *ha-kelev ja?akov axarej-xa le-?an ʃe-**lo** telex*
the-dog 3MSG.follow.FUT after-2MSG to-where that-NEG go.2MSG
'The dog will follow you wherever you go.'

5. **Negative concord** Why are exceptives intervenors for negative concord?

I hope that future research will shed light on these issues.

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Predicting polar question embedding[1]

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Abstract. This paper shows that it is fully predictable whether a polar interrogative clause can appear under a declarative embedding predicate. The idea in a nutshell is as follows: whenever a predicate appears to not embed polar interrogatives, the interpretative component independently derives a trivial meaning for the sentence. Such trivial meanings manifest themselves in unacceptability. A crucial property of this proposal is that interrogative embedding is polarity-sensitive, which is shown to be empirically supported. As a consequence, one must not stipulate in the lexical entry of a given predicate whether or not it embeds polar interrogative clauses.

Keywords: question embedding, logic in grammar, polarity, embedding predicates.

1. Introduction

Know can embed both declarative and polar interrogative clauses, as shown in (1). From this one might expect that any proposition-taking predicate (PTP) shows this behavior.[2] As is well-known, this is, however, not the case. For instance, the closely related PTP *believe* does not embed polar interrogative clauses, as shown in (2). This is somewhat unexpected. The lexical meaning of *believe* is the one of *know* modulo additional meaning components.[3]

(1) a. John knows that Mary smokes.
 b. John knows whether Mary smokes.

(2) a. John believes that Mary smokes.
 b. *John believes whether Mary smokes.

Following Lahiri (2002), I refer to PTPs embedding both declarative and interrogative clauses as responsive and those only embedding the former as non-rogative. The question posed by (1) and (2) can then be stated as in (3).

(3) **The responsiveness puzzle:** Under what conditions is a PTP responsive?

The standard answer to this question, going back to Grimshaw (1979), is that predicates are lexically specified as to which type of complement clause they combine with. The assumption underlying such approaches is that whether a PTP embeds a given clause type is completely arbitrary and not predictable from independent principles. In other words, there simply are no special properties inherent to *know* that make it responsive, as implied by (3).

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[2]Since the standard assumption is that declarative clauses denote propositions, I refer to predicates embedding them as proposition-taking ones.

[3]See for instance Gettier (1963).

This paper takes (3) seriously and argues against Grimshaw's 1979 conviction. Based on the observation that certain PTPs embed polar interrogative clauses only in particular contexts, I suggest that a lexical stipulation approach is untenable. PTPs are generally not specified with respect to whether they embed interrogative clauses or not. Rather, I argue that the distribution of embedded interrogative clauses is fully predictable on semantic grounds alone. The strong thesis followed in this paper is that whenever a PTP is seemingly unable to embed a polar interrogative, this is due to the interpretative component necessarily generating a trivial meaning for the sentence as a whole. Trivial meanings are tautologies and contradictions, which make themselves felt as unacceptability of the sentence (see Gajewski 2002; Chierchia 2006, 2013; Fox and Hackl 2006; Abrusán 2014 a.o.). Two factors play a role in determining whether a meaning is trivial or not: (i) the particular lexical semantics of the PTP, and (ii) the polarity of the sentence as a whole. The apparent impossibility of interrogative embedding under *believe* in (2b), for instance, is due the sentence denoting the tautology. (1b), on the other hand, does not have such a trivial denotation, and thus no degradedness is felt.

I show in the following that this simple approach can deal with numerous types of PTPs. As will be seen, the key insight here is that interrogative embedding necessitates an existential semantics (Spector and Egré 2015, see also Lahiri 2002; Theiler et al. 2016 a.o.). Confining myself to the embedding of polar interrogatives, which is done for reasons of space, moreover allows me to work with completely standard meanings for the PTPs discussed. For *wh*-interrogatives, however, the lexical semantics would have to be somewhat complicated. I refer the reader to Mayr (2017) for discussion of *wh*-interrogatives.[4]

The structure of the paper is as follows. In section 2, I discuss the issue that interrogative embedding poses for a theory of grammar in more detail. Section 3 introduces the proposed system. Section 4 shows its application to the *know-believe* distinction. Section 5 discusses further classes of PTPs. Section 6 concludes the paper.

2. Problems of interrogative embedding

2.1. Arguments for lexical stipulation

Know when embedding a declarative clause, as in (1a), licenses the inference that that clause is true. That is, *know* is veridical.[5] *Believe*, as in (2a), does not do so, i.e., it is non-veridical. An old intuition is therefore that a responsive PTP must be veridical (Hintikka, 1975; Berman, 1991; Ginzburg, 1995a, b; Egré, 2008). Indeed, many veridical PTPs, as in (4), embed interrogative clauses. And many non-veridical ones do not, as in (5). Here and below $\rightsquigarrow X$ and $\not\rightsquigarrow X$ indicate that the example has or does not have the proposition *that X* as an inference.

[4] Given what has just been said, I will not discuss the issue of emotive factive PTPs in this paper. These allow for embedding of *wh*-interrogatives but not of polar interrogatives (see Guerzoni 2007; Sæbø 2007; Nicolae 2013; Romero 2015; Roelofsen et al. ta; Mayr 2017 a.o.).

(i) a. *John *is amazed / happy / surprised* whether Mary smokes.
b. John *is amazed / happy / surprised* which girls smoke.

[5] More precisely, *know* is, of course, not only veridical but also factive. A PTP is factive if the inference that the complement declarative clause is true remains under entailment-cancelling operators.

(4) a. John *deduced / discovered / established / figured out / found out / forgot / learned / recalled / remembered* that Mary smokes. $\leadsto$ *Mary smokes*

b. John *deduced / discovered / established / figured out / found out / forgot / learned / recalled / remembered* whether Mary smokes.

(5) a. John *alleged / asserted / claimed / conjectured / desired / expected / feared / hoped / inferred / wanted / wished* that Mary smokes. $\not\leadsto$ *Mary smokes*

b. *John *alleged / asserted / claimed / conjectured / desired / expected / feared / hoped / inferred / wanted / wished* whether Mary smokes.

This conclusion is, however, called into question by the fact that there are PTPs which embed interrogative clauses yet are non-veridical, as (6) shows (see Grimshaw 1979; Lahiri 2002; Uegaki 2015).

(6) a. John *announced / confirmed / declared / heard / predicted / reported / told us* that Mary smokes. $\not\leadsto$ *Mary smokes*

b. John *announced / confirmed / declared / heard / predicted / reported / told us* whether Mary smokes.

Apart from veridicality, no other semantically discernible property has been found that would separate the responsive PTPs from the non-rogative ones. That is, neither the former nor the latter seem to form a coherent lexical class. It has thus been claimed that it is not predictable given formal semantic properties of a given PTP whether it is responsive or not (Grimshaw, 1979; Uegaki, 2015). In particular, Grimshaw has advanced the view that predicates are specified lexically for so-called s-selectional properties (see also Chomsky 1965; Baker 1968). That is, each PTP is at least specified for whether the embedded clause can be $+$-declarative and $+$-interrogative. The idea here is that such s-selectional specification does not follow from anything more basic.

2.2. Problems for lexical stipulation

According to the lexical specification hypothesis each PTP comes with a feature setting specifying whether an interrogative is a possible complement or not. The surrounding linguistic context should not be able to alter this setting. The data in (7) show that the PTP *be certain* contradicts this prediction. On its own *be certain* can embed declarative clauses as in (7a) but not polar interrogatives as in (7b). With negation as in (7c), however, embedding of a polar interrogative markedly improves (see for instance Eckardt 2007; Egré 2008).

(7) a. John is certain that Mary smokes. $\not\leadsto$ *Mary smokes*

b. *John is certain whether Mary smokes.

c. John isn't certain whether Mary smokes.

Transitive *say*, in contrast to its ditransitive use, and *be convinced* exhibit a behavior parallel to *be certain*, as is shown by (8).

(8) a. John *said / is convinced* that Mary smokes. $\not\rightsquigarrow$ *Mary smokes*
b. *John *said / is convinced* whether Mary smokes.
c. John *didn't say / isn't convinced* whether Mary smokes.

Be certain and the other PTPs just discussed are non-veridical. Interestingly, *be clear* is veridical, and yet it shows the same behavior as *be certain*. In other words, (non)-veridicality is once again not a good indicator as to whether interrogative embedding is possible at all.

(9) a. It is clear that Mary smokes. $\rightsquigarrow$ *Mary smokes*
b. *It is clear whether Mary smokes.
c. It isn't clear whether Mary smokes.

The distribution of polar interrogative clauses as complements of the PTPs above is reminiscent of negative polarity items (NPIs) like *any* (Adger and Quer, 2001), as in (10).

(10) a. *John saw any girl.
b. John didn't see any girl.

Contexts other than negation which allow for NPIs improve the embedding of polar interrogatives under *be certain* as well. Typical such contexts are downward monotonic environments (see Fauconnier 1979; Ladusaw 1979; Linebarger 1987; Krifka 1995; Giannakidou 1999; Chierchia 2004, among many others): antecedents but not consequents of conditionals, negative quantifiers, and restrictors but not scopes of universal quantifiers. Indefinites thus never allow for NPIs. The following demonstrate that polar interrogatives under *be certain* show an NPI-like behavior:

(11) a. If John is certain whether Mary smokes, he knows her well.
b. *If John knows Mary well, he is certain whether she smokes.

(12) a. No student who is certain whether Mary smokes does not know her.
b. No student who does not know Mary is certain whether she smokes.

(13) a. Every student who is certain whether Mary smokes knows her well.
b. ?Every student who knows Mary well is certain whether she smokes.

(14) a. *Some student who is certain whether Mary smokes knows her well.
b. *Some student who knows Mary well is certain whether she smokes.

2.3. Intermediate conclusion

Summarizing, I note two things: (i) the prediction of the lexical specification account that linguistic context cannot affect clausal embedding appears to be wrong. (ii) The way linguistic context affects clausal embedding is systematic and tracks the licensing of NPIs to a considerable extent. In light of this I conclude that the lexical specification hypothesis is untenable.[6]

Now, how could the embedding of polar interrogative clauses be similar to the distribution of NPIs? One of the main contending views regarding NPIs goes as follows: first, *any girl* in (10) denotes an existential quantifier over girls. Second, the sentence has alternatives about particular girls such as *John saw Mary* for (10a) and *John didn't see Mary* for (10b). Third, each sentence in (10) undergoes exhaustification with respect to its alternatives resulting in the conjunction of the sentence—its prejacent—with the negation of the alternatives. This leads to a contradiction without but not with negation, accounting for the pattern in (10) (see Heim 1984; Kadmon and Landman 1993; Krifka 1995; Chierchia 2006, 2013; Crnič 2014, among many others). In the following I show that something similar is happening in the case of the embedding of polar interrogatives.

3. A polarity system for polar interrogative embedding

In the case of polar interrogative clauses, it is the semantics for interrogative embedding necessitating existential quantification (Spector and Egré, 2015). The alternatives are contributed by the embedded interrogative (Klinedinst and Rothschild, 2011). The exhaustification process relative to these alternatives accounts for the patterns discussed in the preceding section.

Assume for *be certain* Hintikka's 1969 universal semantics for propositional attitudes:

(15) $[\![\text{be certain}]\!] = \lambda p_{st}.\lambda x_e.\lambda w_s.\forall w'[w' \in Dox_{x,w} \rightarrow p(w') = 1]$

Be certain applied to a proposition p asserts that p is true in all of the subject's doxastic alternatives. This means p is true in all the worlds doxastically accessible to the subject from the world of evaluation w.

Consider now the sentences in (16) again. Assume that the denotation of the embedded interrogative is as in (17). This is an existential quantifier ranging over a set of propositions, i.e., over a question denotation in the sense of Hamblin (1973) and Karttunen (1977). The set contains the positive and the negative answer to the polar interrogative. In the following, I abbreviate this set as Q'—that is, $\{\lambda w.$ Mary smokes in w, $\lambda w.$Mary doesn't smoke in $w\} = Q'$.

(16) a. John isn't certain whether Mary smokes.
b. *John is certain whether Mary smokes.

(17) $$\begin{aligned}[\![\text{whether Mary smokes}]\!] &= \lambda Q_{\langle st,t\rangle}.\lambda w_s.\exists p[p \in \{\lambda w'.\text{M smokes in } w', \\ &\qquad \lambda w'.\text{M doesn't smoke in } w'\} \wedge Q(p) = 1] \\ &= \lambda Q_{\langle st,t\rangle}.\lambda w_s.\exists p[p \in Q' \wedge Q(p) = 1]\end{aligned}$$

Now, since the denotation of *be certain* requires a proposition as argument, it cannot apply to

[6]To this one might add the observation that the embedding patterns appear to be cross-linguistically stable. From the perspective of a lexical stipulation based account this is unexpected. Languages should be allowed to differ widely with respect to which PTP embeds which clause-type.

(17). Assume therefore, following Lahiri (2002), that the embedded interrogative must take scope over the entire clause, which gives the LFs in (18a) and (18b) for (16a) and (16b), respectively. The operator Exh is discussed below.

(18) a. $[_{S'_1}$ Exh_{Alt} $[_{S_1}$ not [[whether Mary smokes] λp[John is certain p]]]]
b. $[_{S'_2}$ Exh_{Alt} $[_{S_2}$ [whether Mary smokes] λp[John is certain p]]]

For (18a), on the one hand, the denotation of S_1—its literal meaning—corresponds thus to (19). This says that there is no proposition in Q' which is true in all of John's doxastic alternatives. (18b), on the other hand, has as its literal meaning (19b) saying that there is a proposition in Q' that is true in all of John's doxastic alternatives.

(19) a. $[\![S_1]\!]^g = \lambda w.\neg\exists p[p \in Q' \wedge \forall w'[w' \in Dox_{J,w} \rightarrow p(w') = 1]]$
b. $[\![S_2]\!]^g = \lambda w.\exists p[p \in Q' \wedge \forall w'[w' \in Dox_{J,w} \rightarrow p(w') = 1]]$

Consider next the alternatives to the literal meanings in (19a) and (19b). I stipulate them to constitute sets of propositions satisfying the following requirement: each member corresponds to the denotation one would get by replacing the embedded interrogative in (17) with one of its answers in the set Q'. Since the answers are propositions *be certain* can be applied directly.[7]

(20) a. $Alt([\![S_1]\!]^g) = \{\lambda w.\neg\forall w'[w' \in Dox_{J,w} \rightarrow$ Mary smokes in $w']$, $\lambda w.\neg\forall w'[w' \in Dox_{J,w} \rightarrow$ Mary doesn't smoke in $w']\}$
b. $Alt([\![S_2]\!]^g) = \{\lambda w.\forall w'[w' \in Dox_{J,w} \rightarrow$ Mary smokes in $w']$, $\lambda w.\forall w'[w' \in Dox_{J,w} \rightarrow$ Mary doesn't smoke in $w']\}$

Finally, each literal meaning derived in (19) is strengthened relative to its alternatives in (20). This is done with the help of the Exh-operator defined in (21) (see Groenendijk and Stokhof 1984; Krifka 1995; van Rooij and Schulz 2004; Chierchia 2006, 2013; Fox 2007; Spector 2007, among many others). Exh takes a proposition p—the prejacent S_1 or S_2— asserts it and states that all propositions which are not Strawson-entailed by p are false. In the following $\Rightarrow$ indicates regular entailment, and $\Rightarrow_S$ Strawson-entailment. In the particular case at hand and more generally whenever a sentence is presuppositionless, Strawson-entailment reduces to regular entailment. For more discussion, see section 4.2.[8]

(21) $[\![\text{Exh}_{Alt}]\!] = \lambda w_s.p(w) = 1 \wedge \forall q \in Alt[p \not\Rightarrow_S q \rightarrow q(w) = 0]$

The denotation of the prejacent S_1 of Exh in (18a), i.e., (19a), entails each of its alternatives in (20a). If John is ignorant with respect to whether Mary smokes, then it follows both that John is not certain that Mary smokes and that he is not certain that Mary does not smoke. As

[7] This can be derived more formally by having the existential quantifier ranging over Q' be restricted to exactly one of the answers in Q'. Such an implementation would use Chierchia's 2006 notion of domain alternatives.

[8] Entailment and Strawson-entailment (von Fintel, 1999) are defined as follows:

(i) a. For any $p,q \in D_{st}$, p entails q, $p \Rightarrow q$, iff for all $w \in D_s$ such that $p(w) = 1$, $q(w) = 1$.
b. For any $p,q \in D_{st}$, p Strawson-entails q, $p \Rightarrow_S q$, iff for any presupposition r of q and all $w \in D_s$ such that $p(w) = r(w) = 1$, $q(w) = 1$.

a consequence Exh does not negate any of the alternatives, and the strengthened interpretation of (16a) is equivalent to its literal one without Exh:

(22) $[\![\mathrm{S}'_1]\!]^g = \lambda w.\neg\exists p[p \in Q' \wedge \forall w'[w' \in Dox_{J,w} \rightarrow p(w') = 1]]$

(22) corresponds to the intuitive interpretation of the sentence. In particular, consider the sentence in the context in (23). Here it is unacceptable because the truth-conditions in (22) require John to not believe any of the propositions in Q', which contradicts the context. Notice that (23) provides direct evidence for the assumption that there is existential quantification over answers involved (Spector and Egré, 2015). If the truth-conditions were about a particular answer, the sentence should be acceptable.

(23) **Context:** Mary smokes, but John believes she does not smoke.
#John isn't certain whether Mary smokes.

Consider next the denotation of the prejacent S_2 of Exh in (18b) given in (19b). Each of its alternatives in (20b) entails it. For instance, if John believes that Mary smokes, then there is a proposition in Q' that John believes. Consequently, Exh negates each of the alternatives and conjoins them with the denotation of the prejacent yielding (24).

(24)
$$\begin{aligned} [\![\mathrm{S}'_2]\!]^g = \lambda w.&\exists p[p \in Q' \wedge \forall w'[w' \in Dox_{J,w} \rightarrow p(w') = 1]] \wedge \\ &\neg\forall w'[w' \in Dox_{J,w} \rightarrow \text{Mary smokes in } w'] \wedge \\ &\neg\forall w'[w' \in Dox_{J,w} \rightarrow \text{Mary doesn't smoke in } w'] \\ = \top& \end{aligned}$$

(24) is equivalent to saying that John either believes that Mary smokes or that he believes that she does not smoke but that he neither believes that she smokes nor that he believes that she does not smoke. This is a contradiction. Following Gajewski (2002), Fox and Hackl (2006), Chierchia (2006, 2013), Abrusán (2014) a.o., I assume that such trivial meanings lead to judgements of degradedness.

This assumption regarding triviality thus derives the pattern in (16). In particular, the system sketched here explains why *be certain* and other PTPs are only sometimes responsive. Moreover, the crucial reason why negation did not result in a contradiction and allowed for embedding of polar interrogatives was that it reverses the entailment patterns between the literal interpretation and the alternatives. As a consequence it follows that any entailment reversing environment, such as the downward monotonic contexts discussed in section 2.2 above, are predicted to not result in contradictions either.

4. The *know-believe* distinction

Let me now return to the responsiveness puzzle and in particular the difference between *know* and *believe*. As already discussed, the former embeds polar interrogatives whereas the latter does not do so. Moreover, we need to add to this the observation that negation does not seem to affect either of these properties. The picture as it presents itself is thus as in (25) and (26).

(25) a. John knows whether Mary smokes.
b. John doesn't know whether Mary smokes.

(26) a. *John believes whether Mary smokes.
b. *John doesn't believe whether Mary smokes.

Now, both *know* and *believe* have lexical properties differentiating them from each other, but setting them also apart from *be certain*. *Know*, on the one hand, is factive, whereas the other two PTPs are not:

(27) a. John (doesn't) know(s) that Mary smokes. $\rightsquigarrow$ *Mary smokes*
b. John (doesn't) believe(s) that Mary smokes. $\not\rightsquigarrow$ *Mary smokes*
c. John is(n't) certain that Mary smokes. $\not\rightsquigarrow$ *Mary smokes*

Believe, on the other hand, is a neg-raising predicate (Horn, 1978). When negated it appears that the negation takes scope below *believe* giving rise to a stronger than expected inference, as shown in (28b). Neither *know* nor *be certain* is neg-raising, as (28a) and (28c) show.

(28) a. John doesn't know that Mary smokes. $\not\rightsquigarrow$ *John knows that Mary doesn't smoke*
b. John doesn't believe that Mary smokes.
$\rightsquigarrow$ *John believes that Mary doesn't smoke*
c. John isn't certain that Mary smokes. $\not\rightsquigarrow$ *John is certain that Mary doesn't smoke*

In the following, I show how the lexical properties of neg-raising and factivity interact with the system sketched in the preceding section thereby deriving the patterns in (25) and (26).

4.1. Neg-raising

Following Bartsch (1973), Löbner (2003) and Gajewski (2007) a.o., I assume that neg-raising PTPs presuppose that the subject is opinionated about the truth of the complement clause. That is, *believe* has a denotation parallel to *be certain* but presupposes that the subject either believe the propositional argument to be true or believe it to be false:[9]

(29) $$[\![\text{believe}]\!] = \lambda p_{st}.\lambda x_e.\lambda w_s : \underline{\forall w'[w' \in Dox_{x,w} \to p(w') = 1] \vee \forall w'[w' \in Dox_{x,w} \to p(w') = 0]}\ .\ \forall w'[w' \in Dox_{x,w} \to p(w') = 1]$$

In the positive case of (27b) the presupposition in (29) is harmless as it is entailed by and in fact equivalent to the assertive component. In the negative case, however, the presupposition entails the assertion. The consequence of this is that even though the assertion has weak wide-scope negation, the presupposition strengthens the intuited inference to a meaning saying that John believes that Mary does not smoke.

[9] I adopt here and in the following Heim and Kratzer's 1998 notation for presuppositions, according to which $\lambda\chi : \phi\ .\ \psi$ is a function that is only defined for objects χ such that ϕ holds. In addition presuppositions are underlined.

Consider now the degraded (30) repeated from above. Its truth-conditions before exhaustification are as in (31). What is the presupposition of (31)? Taking the first of the propositions in Q' and setting it for p in (31) gives the presupposition that John either believes that Mary smokes or that she does not smoke. Taking the second proposition in Q', however, yields exactly the same. As a consequence, the presupposition of (31) is that John either believes that Mary smokes or that she does not smoke. Given the existential quantification in the assertive component of (31), the assertion is equivalent to the presupposition. This means that whenever (31) has a defined truth-value, it is true. It is a tautology. Therefore (30) has a trivial literal meaning and is degraded even without exhaustification.

(30) *John believes whether Mary smokes.

(31) $[\![(30)]\!]^g = \lambda w. \exists p \in Q' : \underline{\forall w'[w' \in Dox_{J,w} \rightarrow p(w') = 1] \vee \forall w'[w' \in Dox_{J,w} \rightarrow p(w') = 0]} \,.\, \forall w'[w' \in Dox_{J,w} \rightarrow p(w') = 1]$

Given this it is easy to see why (32) is also degraded.

(32) *John doesn't believe whether Mary smokes.

The truth-conditions are as in (33). The presupposition requires again that John either believes that Mary smokes or that she does not smoke. The assertive component now states that John does not believe any of the propositions in Q'. Thus whenever (33) is defined, it is false. (31) is therefore degraded because it also has a trivial literal meaning.

(33) $[\![(32)]\!]^g = \lambda w. \neg\exists p \in Q' : \underline{\forall w'[w' \in Dox_{J,w} \rightarrow p(w') = 1] \vee \forall w'[w' \in Dox_{J,w} \rightarrow p(w') = 0]} \,.\, \forall w'[w' \in Dox_{J,w} \rightarrow p(w') = 1]$

This treatment of *believe* predicts, of course, that other neg-raising PTPs are similarly nonrogative regardless of the polarity of the surrounding linguistic context. This is indeed the case as (34) and (35) show.

(34) a. John doesn't *expect* / *reckon* / *think* / *assume* / *presume* / *reckon* that Mary drinks.
$\rightsquigarrow$ *John P-s that Mary doesn't drink*

b. *John (doesn't) *expect(s)* / *reckon(s)* / *think(s)* / *assume(s)* / *presume(s)* / *reckon(s)* whether Mary drinks.

(35) a. It isn't *advisable* / *desirable* / *likely* / *probable* that Mary drinks.
$\rightsquigarrow$ *It is P that Mary doesn't drink*

b. *It is(n't) *advisable* / *desirable* / *likely* / *probable* whether Mary drinks.

The idea that neg-raising PTPs lead to trivial meanings when embedding an interrrogative goes back to Zuber (1982), though it is implemented differently there (see also Theiler et al. 2016).

4.2. Factivity

Assume the standard lexical entry for *know* in (36). (36) applied to a proposition p and an individual x states that x believes p and presupposes that p is true.

(36) $[\![\text{know}]\!] = \lambda p_{st}.\lambda x_e.\lambda w_s : \underline{p(w) = 1} \, . \, \forall w'[w' \in Dox_{x,w} \rightarrow p(w') = 1]$

As a consequence the literal meaning of (37) is as in (38).

(37) John knows whether Mary smokes.

(38) $[\![(37)]\!]^g = \lambda w.\exists p \in Q' : \underline{p(w) = 1} \, . \, \forall w'[w' \in Dox_{J,w} \rightarrow p(w') = 1]$

The literal meaning in (38) is non-trivial. It asserts that there is a proposition p in Q' that John believes. It presupposes that p is true in w. Thus in a world in which Mary smokes (38) says that John believes that Mary smokes, and in a world in which she does not smoke (38) says that she does not do so. That is, the factivity of *know* ensures that the subject stand in the know-relation to the true answer, whatever it is. Given the discussion in section 3, the alternatives to (38) used for strengthening by Exh are as in (39).

(39) $Alt([\![\text{S}]\!]^g) = \{\lambda w : \underline{\text{Mary smokes in } w} \, . \, \forall w'[w' \in Dox_{J,w} \rightarrow \text{Mary smokes in } w'],$
$\lambda w : \underline{\neg\text{Mary smokes in } w} \, . \, \forall w'[w' \in Dox_{J,w} \rightarrow \neg\text{Mary smokes in } w']\}$

Now recall that Exh negates only those alternatives that are not Strawson-weaker than its prejacent, i.e., those alternatives that are not Strawson-entailed by the prejacent. As defined in footnote 8 following von Fintel (1999), for a proposition p to Strawson-entail a proposition q the presuppositions of q must be assumed to be true. When we want to see whether (38) Strawson-entails the first alternative in (39), we must therefore assume that Mary smokes in some particular world w_o as in (40a), as this is the presupposition of the alternative. Now, (38) is true in w_o if (40b) holds. Since the two propositions in Q' contradict each other, the proposition in Q' that John knows in w_o must be that Mary smokes given (40a). Thus (40a) together with (40b) guarantees that Mary smokes is the true answer to Q' in w_o and that John believes that Mary smokes is true. Therefore, (38) Strawson-entails the first alternative in (39), as stated in (40c). By the same logic (38) also Strawson-entails the second alternative in (39). In fact, it is Strawson-equivalent to both its alternatives.

(40) a. Mary smokes in w_o.
b. For some $p \in Q'$, John knows p in w_o.
c. (40a) & (40b) $\Rightarrow_S$ John knows in w_o that Mary smokes.

As a consequence, Exh does not negate any of the alternatives, and the strengthened meaning of (37) is equivalent to its literal meaning in (38). Since this meaning is non-trivial, we have explained why (37) is acceptable. We also immediately explain why its negation in (41) is equally acceptable. Since it is the factive presupposition of *know* that makes the alternatives Strawson-equivalent to the literal meaning, it follows that further embedding under negation will not affect the result just obtained.

(41) John doesn't know whether Mary smokes.

The first consequence of this treatment for *know* is that factive PTPs in general should be responsive. This is by and large borne out. All the veridical PTPs in (42), repeated from (4), are actually factive, thus explaining (42b).

(42) a. John *deduced / discovered / established / figured out / found out / forgot / learned / recalled / remembered* that Mary smokes. $\rightsquigarrow$ *Mary smokes*
b. John *deduced / discovered / established / figured out / found out / forgot / learned / recalled / remembered* whether Mary smokes.

Second, veridical PTPs that are not factive, such as *be clear*, are not predicted to license interrogative embedding across-the-board. Here a downward monotonic environment is necessary for embedding to be possible:

(43) a. It is clear that Mary smokes. $\rightsquigarrow$ *Mary smokes*
b. It isn't clear that Mary smokes. $\not\rightsquigarrow$ *Mary smokes*

(44) a. *It is clear whether Mary smokes.
b. It isn't clear whether Mary smokes.

Third, it should be stressed that the polarity system proposed in section 3 makes the fact that *be certain* embeds interrogatives only under negation the flip-side of the fact that *know* always does so.

Finally, note that the use of Strawson-entailment rather than of regular entailment is crucial for the account. One might therefore ask why this particular type of entailment should be used. I do not have an answer to this. However, NPI-licensing in general is subject to Strawson-entailment. As is well-known, it is the Strawson-donward-monotonic property of *only* that lets it license NPIs (von Fintel, 1999).

5. Other non-veridical predicates

5.1. Ambiguous predicates and being about the true answer

Recall now the PTPs in (45). In section 2.1 they were shown to be problematic for accounts relating interrogative embedding to veridicality directly. The reason for this is that the PTPs are non-veridical.

(45) a. John *announced / confirmed / declared / heard / predicted / reported / told us* that Mary smokes. $\not\rightsquigarrow$ *Mary smokes*
b. John *announced / confirmed / declared / heard / predicted / reported / told us* whether Mary smokes. $\rightsquigarrow$ *John P-ed the true answer to "Does Mary smoke?"*

As seen in section 4.2, the present system does not rely on a connection between veridicality and responsiveness. Still, as it stands it does not predict the pattern in (45) either.

Now, notice that the PTPs are veridical with respect to the embedded interrogative: (45b) licenses the inference that the subject stand in the relation denoted by the PTP to the true answer to the embedded interrogative. Following Spector and Egré (2015), I assume that the PTPs in (45) come in both a factive and a non-factive version. Consider *tell* for concreteness. In (45a), on the one hand, its non-factive version in (46) is, or at least can be chosen. Thereby no veridicality inference is felt.

(46) $[\![\text{tell}_1]\!] = \lambda p_{st}.\lambda y_e.\lambda x_e.\lambda w_s.\ \forall w'[w' \text{ is compatible with what } x \text{ tells } y \text{ in } w \rightarrow p(w') = 1]$

The reason why, on the other hand, in (46b) the factive version in (47) must be chosen is now straightforwardly explained on the present account: using the non-factive version of *tell* in (46) would result in a trivial strengthened meaning and thereby degradedness. That is, it would lead to a contradiction after exhaustification completely parallel to what we have seen with *be certain* in section 3. On its factive interpretation, however, *tell* works just like *know*. Factivity blocks the contradiction otherwise derived by exhaustification, as seen in section 4.2.

(47) $[\![\text{tell}_2]\!] = \lambda p_{st}.\lambda y_e.\lambda x_e.\lambda w_s : \underline{p(w) = 1}\ .$
$\forall w'[w' \text{ is compatible with what } x \text{ tells } y \text{ in } w \rightarrow p(w') = 1]$

Recall moreover from section 4.2 that the factivity presupposition of *know* guarantees that the subject stand in the know-relation to the true answer to the embedded interrogative, whatever it is. The limited veridicality inference in (45b) with respect to the true answer thus follows on the present account: only (47) can be used here, and this necessitates a relation between the subject and the true answer. As far as I am aware, the present account is the first to be in a position to explain why seemingly non-veridical PTPs must be about the true answer when embedding an interrogative clause as in (45b).

This makes a testable prediction. Whenever one of the PTPs from (45) embeds an interrogative clause and moreover occurs in an environment where contradiction by exhaustification is avoided independently, the non-factive interpretation should be usable. That is, not even limited veridicality as in (45b) should ensue.

Consider (48). The sentence is odd in the context given. Now notice that on the factive interpretation of *tell* in (47) the sentence should be acceptable, as it would assert that John did not tell us the true answer to *Does Mary smoke?*. Since the context satisfies this, we conclude that the sentence does not have such truth-conditions. Without a factive presupposition, the sentence states that John did not tell us any possible answer to the question *Does Mary smoke?*. These truth-conditions are not fulfilled by the context accounting for the degradedness.

(48) *Context: John told us that Mary smokes, which is in fact false.*
#John didn't tell us whether Mary smokes.

The degradedness in (48) more precisely suggests that the factive version of *tell* and similarly ambiguous PTPs becomes usable only when the non-factive one would lead to a contradiction via exhaustification. This is unlike what Spector and Egré (2015) suggest. They argue that such PTPs can always have the non-factive interpretation when embedding interrogative clauses. They cite (49) as evidence for this, minimally modified to show a polar interrogative here. (49) seemingly does not require the subject to stay in a relation to the true answer.

(49) Every day, the meteorologists *tell* the population / *predict* / *announce* whether it will rain the following day, but they are often wrong.

I suggest that the fact that (49) is not degraded is entirely expected on the present account. The surfacing of the non-factive interpretations of the PTPs involved is, in particular, due to the fact that they are embedded under the universal temporal quantifier *every day*. First, (49) becomes less acceptable when *every day* is absent:

(50) #The meteorologists *tell* the population / *predict* / *announce* whether it will rain the following day, but they are often wrong.

Second, note that other universal quantifiers also license the use of the non-factive interpretation of the PTP:

(51) The meteorologists are required to *tell* the population / *predict* / *announce* whether it will rain the following day, even if they don't know.

It is well-known that universal quantifiers obviate contradictions which would otherwise arise through exhaustification when occurring unembeddedly (e.g. Fox and Hackl 2006; Fox 2007; Chierchia 2013; Abrusán 2014). Let me show how this works for (51). Its LF with non-factive *tell* would be something like (52).

(52) $[_{S'}$ Exh$_{Alt}$ $[_{S}$ required [[whether it will rain] λp[the meteorologists to tell$_1$ the population p]]]]

The literal meaning of S states that in every deontically accessible world the meteorologists tell the population a possible answer to the question *Will it rain?*. This neither entails that in every such world the meteorologists tell the population that it will rain nor that in every world they tell them that it will not rain. That is, the literal meaning does not entail its alternatives. Therefore Exh negates them giving the strengthened meaning in (53).

(53) $$\begin{aligned}[][\![S']\!]^g = 1 \text{ iff } & \forall w'.\exists p[p \in Q' \wedge \text{ the meteorologists tell the population } p \text{ in } w'] \wedge \\ & \neg\forall w'[\text{the meteorologists tell the population in } w' \text{ it will rain}] \wedge \\ & \neg\forall w'[\text{the meteorologists tell the population in } w' \text{ it will not rain}]\end{aligned}$$

Crucially, (53) is not trivial. (53) states that the meteorologists are required to tell the population some answer but that they are neither required to tell them that it will rain nor that they are required to tell them that it will not rain.

This raises the question why (54) with an existential modal is similarly acceptable, even though existential modals generally do not obviate contradictions via exhaustification.

(54) The meteorologists are allowed to *tell* the population / *predict* / *announce* whether it will rain the following day, even if they don't know.

I suggest that in cases like (54) it is actually the factive version of the PTP that is used, as in the LF in (55), with Exh embedded under the modal.

(55) $[_{S'}$ allowed $[_{S}$ Exh$_{Alt}$ [[whether it will rain] λp[the meteorologists to tell$_2$ the population p]]]]

This delivers the interpretation of S′ in (56). First, notice that the alternatives to the prejacent of Exh are Strawson-equivalent to the prejacent. That is, Exh does not negate any of them, as in the case of *know* discussed in section 4.2. Second, the factive presupposition of *tell* is interpreted with respect to the world bound by the existential modal. As a consequence (56) says that in some deontically accessible world the meteorologists tell the population the true answer to the interrogative in that world. This does not entail anything about the true answer in the actual world. Now, if *know* in (54) moreover introduces a presupposition about the actual world, this does not lead to a contradiction with (56). In other words, with embedded exhaustification and the factive use of *tell*, (54) does not come out as degraded.

(56) $[\![S']\!]^g = 1$ iff $\exists w'.\exists p \in Q' : \underline{p(w') = 1}$. the meteorologists tell the population p in w'

5.2. Predicates with an order-based semantics

Recall now the following desiderative PTPs from (5). (57a) has the inference that John prefers Mary smoking to her not smoking. This is generally accounted for by attributing an order-based semantics to the PTPs.

(57) a. John *desired / wanted / wished* that Mary smokes. $\not\rightsquigarrow$ *Mary smokes*
$\rightsquigarrow$ *John prefers Mary to smoke*

b. *John *desired / wanted / wished* whether Mary smokes.

Since the PTPs in (57) are all non-veridical, we might expect interrogative embedding to improve under negation, similarly to *be certain*. But this is not the case as (58) shows. The PTPs in (58) are thus closer to *believe*.

(58) *John didn't *desire / want / wish* whether Mary smokes.

Indeed, such desiderative PTPs are neg-raising. Consider (59). If *want* were not neg-raising, (59) should be compatible with John not having a preference as to whether Mary smokes or not given the inference observed for (57a). However, (59) rather implies that John prefers Mary to not smoke.

(59) John doesn't want that Mary smokes. $\rightsquigarrow$ *John prefers Mary to not smoke*

This suggests that the account offered for *believe* in 4.1 should be extendable to desiderative PTPs. Notice, however, that such PTPs are non-monotonic (see e.g. Asher 1987; Heim 1992; Villalta 2008; Lassiter 2011; Rubinstein 2012; Anand and Hacquard 2013 a.o.). (60a) does not entail (60b).

(60) a. John *desired / wanted / wished* that Mary and Sue smoke.
b. John *desired / wanted / wished* that Mary smokes.

To account for this non-monotonicity property, I adopt Heim's 1992 similarity-based account of desiderative predicates. The entry for *want*, for instance, is as in (61). (61) applied to a proposition p asserts that for all of the subject's doxastic alternatives w' the worlds most similar to w' in which p is true are more desirable to the subject in w than the worlds most similar to w' in which p is false.[10] Applied to (60a), for instance, (61) says that John believes that if Mary and Sue smoke he is in a more desirable world than if they do not smoke. The counterfactual component in (61) blocks entailment in both directions in (60). Crucially, (61) has the opinionatedness presupposition familiar from *believe* built in.

(61) $$[\![\text{want}]\!] = \lambda p_{st}.\lambda x_e.\lambda w_s.\frac{[\forall w' \in Dox_{x,w}.Sim_{w'}(p) >_{x,w} Sim_{w'}(\neg p)] \vee [\forall w' \in Dox_{x,w}.Sim_{w'}(\neg p) >_{x,w} Sim_{w'}(p)]}{\forall w' \in Dox_{x,w}.Sim_{w'}(p) >_{x,w} Sim_{w'}(\neg p)}.$$

Consider now the ungrammatical (57b) with *want*. Its literal meaning is as in (62). Given the existential quantification over answers, the assertive component says that John prefers Mary smoking to her not smoking or he prefers the reverse.

(62) $$[\![(57\text{b})]\!] = \lambda w.\exists p \in Q' : \frac{[\forall w' \in Dox_{J,w}.Sim_{w'}(p) >_{J,w} Sim_{w'}(\neg p)] \vee [\forall w' \in Dox_{J,w}.Sim_{w'}(\neg p) >_{J,w} Sim_{w'}(p)]}{\forall w' \in Dox_{J,w}.Sim_{w'}(p) >_{J,w} Sim_{w'}(\neg p)}.$$

Now, since the two possible answers are the negations of each other, they make the same contribution to the presuppositional component. Each says that John either prefers Mary to smoke or he prefers the reverse. Thus the presupposition of (62) is equivalent to the assertion. Therefore the literal meaning of (57b) is trivial. Now, the negation in (58) has the same presupposition as (62). But the assertive component now requires that John have no preference among the possible answers. This contradicts the presupposition and thus (58) also has a trivial literal meaning. In other words, the order-based semantics of desiderative PTPs does not interfere with their neg-raising property, and they come out as non-rogative, as desired. This treatment

[10]The similarity relation among worlds and the notion of desirability employed in (60) are defined as in (i) and (ii), following again Heim (1992: 195ff.).

(i) $Sim_w(p) := \{w'' \in W : w'' \in p$ and w'' resembles w no less than any other world in $p\}$
(ii) a. For any $w, w', w'' \in W$, $w' >_{\alpha,w} w''$ iff w' is more desirable to α in w than w''.
b. For any $w \in W, X \subseteq W, Y \subseteq W$, $X >_{\alpha,w} Y$ iff $w' >_{\alpha,w} w''$ for all $w' \in X, w'' \in Y$.

can be extended to other neg-raising PTPs in (5) with an order-based semantics, such as *expect*, *fear* and *hope*.

6. Conclusion and outlook

In this paper I argued that embedding of polar interrogative clauses under PTPs involves an existential semantics, as suggested more generally by Spector and Egré (2015). This allowed me to account for the surprising context-dependence of the embedding of such clauses under *be certain* and other PTPs. Specifically, I proposed an exhaustification-based polarity system (Krifka, 1995; Chierchia, 2006, 2013) which leads to a contradiction for polar interrogatives with unnegated *be certain*. This system moreover has the immediate consequence that polar interrogatives can be embedded under factive PTPs even when not negated. The reason is that factivity avoids contradiction by exhaustification. This proposal also explains why seemingly non-veridical PTPs like *tell* show a limited kind of veridicality when embedding polar interrogatives. The reason is, again, that otherwise a contradiction would ensue. Finally, the existential semantics for embedding of polar interrogatives predicts that neg-raising PTPs—even those with an order-based semantics—always give rise to trivial meanings. That is, the system predicts such PTPs to never embed polar interrogatives.

The most important issue for future research now is to investigate how the proposed system can be extended to *wh*-interrogatives. First, the existential semantics assumed in this paper does not directly work with *wh*-interrogatives. It would give rise to too weak mention-some interpretations. Second and connected to this, the factivity presupposition assumed in the present paper does not automatically yield Strawson-equivalence in the case of *wh*-interrogatives embedded under factive PTPs. I.e., they should not be licensed contrary to fact. The consequence of this is that the lexical semantics for the PTPs themselves must be altered somewhat. For discussion of how this can be done, I refer the reader to Mayr (2017).

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Modal subordination of propositional anaphora: On the role of tense and the modal particle *ook* in contextual counterfactuals in Dutch[1]

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Abstract. This paper examines a variant of modal subordination that involves reference to propositions that have been introduced in the scope of a negative operator. In the dialogues under consideration, this kind of reference is most reliably established if the modal particle (MP) *ook* and past perfect morphology are present in the response, which contains the anaphor (Meijer 2016). We provide experimental evidence that supports this empirical claim and provide a theoretical explanation for the data. We assume that the discourses at issue involve contextual counterfactuals (CFs) whose antecedent may be positive or negative and provides the antecedent for the anaphor. CFs with a negative antecedent 'doubt' the truth of the previous utterance, whereas CFs with a positive antecedent do not. As a consequence, the MP, which presupposes that the epistemic modal base already entailed the previously uttered proposition, is incompatible with the former but not the latter type of CF (Meijer 2016). For the tense marking we propose that the effects are due to the local interpretation of the non-*fake* tense in the consequent of the CF (cf. Ippolito 2013).

Keywords: modal subordination, modal particles, propositional anaphora, counterfactuality

1. The phenomenon

Propositions can be targeted by demonstrative pronouns like English *that*, see (1), where the proposition denoted by a declarative clause is the referent that is picked up by *that* in the subsequent sentence. We may say that the first clause introduces a propositional discourse referent (e.g. Asher 1986, 1993; Geurts 1998). That referent is targeted by *that*. Krifka (2013) suggests that clauses with sentential negation introduce two propositional discourse referents: the negative proposition that is denoted by the entire clause, and the positive proposition that is denoted by the syntactic object below the negation. Evidence for this claim comes from data like (2). (2B) and (2B') are possible discourse continuations of the negative assertion (2A). Both contain the pronoun *that*. In (2B), *that* refers to the negative proposition $\neg\phi$, *two plus two is not five*. In (2B'), *that* refers to the positive proposition ϕ, *two plus two is five*. Note that (2B') contains the modal verb *would*, whereas (2B) does not contain a modal verb.

(1) [John was out last night]$_\phi$. Mary knew that$_\phi$.

(2) A: Two plus two isn't five. $\equiv \neg\phi$ (Krifka 2013)
B: Everyone knows that$_{\neg\phi}$. B': That$_\phi$ would be a contradiction.

[1]We would like to thank Maribel Romero, Manfred Krifka and the audiences at Sinn und Bedeutung 21 and ConSOLE XXIV for discussion.

Reference to antecedents that are in the scope of negation or of intensional operators was first described for nominal anaphora by Roberts (1989), see (3a-b) and (4a-b). In the first utterance of these discourses, there is an indefinite that introduces a discourse referent in the scope of an intensional operator (*a book* in (3a)), or in the scope of negation (*a car* in (4a)). In the second utterance, (3b) and (4b), which both contain a modal verb (*will/would*), a pronoun refers back to the discourse referent that was introduced in the first utterance. (3b') and (4b') are minimal variants of (3b) and (4b) without a modal verb. These variants are not felicitous continuations of (3a) and (4a). Thus, in order to establish reference to a discourse referent below an intensional operator or negation in the previous utterance, a modal must be used.

(3) a. If John bought [a book]$_i$, he will be home reading it by now. (Roberts 1989:683)
b. It$_i$'ll be a murder mystery. b'. # It$_i$ is a murder mystery.

(4) a. John doesn't have [a car]$_i$. (Roberts 1997:239)
b. It$_i$ would be in the garage. b'. # It$_i$ is in the garage.

The propositions denoted by the clauses in (3b) and (4b) are said to be *modally subordinated* to the propositions in (3a) and (4a) (Roberts 1989, 1997). The modal base of the modal in the second utterance is restricted: in (3) by the proposition in the antecedent of the conditional; in (4), by the accommodated counterfactual proposition *John bought a car*. In the restricted domain of the modal, the familiarity presupposition for the use of the respective pronoun is fulfilled because *a book* and *a car* are given in that domain. Roberts (1997) highlights that domain restriction across utterances can be compared with domain restriction in conditionals, where the antecedent restricts the domain of the consequent. So for instance (4b) can be paraphrased as *if John had a car, it would be in the garage*.

Going back to Krifka's example for anaphoric reference to a proposition under negation, the presence of *would* is not surprising from the perspective of modal subordination involving nominal anaphora. The example is an instance of modal subordination involving a propositional anaphor. However, interestingly, the presence of a modal does not always seem to be necessary to refer to a propositional discourse referent in the scope of negation, see (5). In the continuations (5B/B'), there is no modal verb. Both continuations are felicitous although they differ with respect to the reference of *that*, which seems to be due to the presence vs. absence of a negation. If there is a negation, as in (5B), *that* refers to the positive proposition ϕ, *you won the jackpot*. If there is no negation, *that* refers to the negative proposition $\neg\phi$, *you did not win the jackpot*. Goodhue and Wagner (resubm.) suggest that these different interpretations are due to our world knowledge. Winning the jackpot is unlikely whereas not winning it is likely.

(5) A: You didn't win the jackpot. $\equiv \neg\phi$ (Goodhue and Wagner resubm.)
B: I didn't expect that$_{\phi}$. B': I expected that$_{\neg\phi}$.

Although a modal does not always seem to be necessary to refer to a proposition under negation, in certain contexts the presence of a modal does not seem to be sufficient. Consider the Dutch discourses in (6) (Meijer 2016). (6A) is a negative assertion. (6B) is a felicitous continuation, in which the speaker uses a predicate of personal taste to express their opinion about what was stated in the assertion. As the difference between (6B/B') indicates, reference to the positive proposition with the demonstrative pronoun *dat* 'that' only is possible if in addition to a modal verb (here *zouden* 'would'), the MP *ook* (literally 'also') as well as a past participle (*geweest* 'been') are present (Meijer 2016). In (6B), which contains *ook* and the past participle *geweest*, *dat* refers to the positive proposition ϕ, *Jan worked yesterday*. (6B') is infelicitous on the reading that involves reference to the non-negated proposition (Meijer 2016). It is worth pointing out here that (6B') is coherent if *dat* is interpreted as referring to $\neg\phi$. (7) illustrates that German seems to behave similarly regarding the anaphoric possibilities of the pronoun *das* 'that' in the presence vs. absence of the MP *auch* (lit. 'also') and the past participle *gewesen* 'been'.[2] In this paper, we will use the terms ϕ-reference vs. $\neg\phi$-reference, in order to distinguish the two interpretations of *dat*, viz. as referring to ϕ vs. $\neg\phi$.

(6) A: Jan heeft gisteren niet gewerkt. $\equiv \neg\phi$
Jan has yesterday not worked
'Jan didn't work yesterday.'
B: Das$_{\phi/\#\neg\phi}$ zou ook raar zijn geweest.
that MOD OOK strange be been
'That would have been strange.'
B': Dat$_{\#\phi/\neg\phi}$ zou raar zijn.
that MOD strange be
'That would be strange.'

(7) A: Hans hat gestern nicht gearbeitet. $\equiv \neg\phi$
Hans has yesterday not worked
B: Das$_{\phi/\#\neg\phi}$ wäre auch komisch gewesen.
that BE.SBJV AUCH strange been
B': Das$_{\#\phi/\neg\phi}$ wäre komisch.
that BE.SBJV strange

Note that similar to Roberts' cases of modal subordination involving nominal anaphora, (6B) and (7B) express conditional readings. Meijer (2016) calls such utterances *contextual counterfactuals*. Speaker B seems to accommodate an antecedent for a counterfactual (CF) conditional whose consequent is uttered overtly: *if Jan had worked yesterday, that would have been strange.* The antecedent of the CF provides the referent ϕ which is picked up by *dat/das* in the consequent. Turning to (6B') and (7B'), we could assume that the accommodated CF plausibly is *if Jan hadn't worked yesterday, that would be strange.* Again, the antecedent of the CF provides the referent that is picked up by *dat/das* in the consequent, in this case this is $\neg\phi$. However, there is an important difference between the CFs that are accommodated in the (B)- vs. (B')-versions. In the (B)-versions, the second speaker accepts what the first speaker said as true: In the actual world Jan did not work. It is in the CF worlds that Jan worked. In the (B')-version, in contrast, the second speaker doubts what the first speaker said, i.e. it is not established as common ground that Jan did not work. Rather, the second speaker implicates that Jan did work.

[2] Some native speakers of German report that (7B') is not coherent for them even on a $\neg\phi$-reading. It seems that the midclause insertion of the conjunction *aber* 'but' improves (7B') as in *Das wäre aber komisch*. We assume that the improvement is due to *aber* overtly marking the contrast with the previous utterance – after all, speaker B' calls into doubt the utterance by the first speaker. See below for elaboration.

It is important to note at this stage that discourses involving predicates of personal taste only seem to enable ϕ-reference if the predicate of personal taste is one of surprise or wonderment. Consider the response in (8B), which is minimally different from the one in (6B'): the predicate *normaal* 'usual' replaces the predicate *raar* 'strange'. A proposition whose truth one finds normal, i.e. expects to be true cannot be surprisingly or unexpectedly true. The discourse in (8) is incoherent – with any kind of reference. The same observation holds for German (not illustrated). We will not explore the role of the type of predicate of personal taste in this paper and restrict our discussion to predicates of surprise/wonderment (for details see Meijer 2016).[3]

(8) A: Jan heeft gisteren niet gewerkt.
Jan has yesterday not worked
'Jan didn't work yesterday.'

B: #Dat$_{\phi/\neg\phi}$ zou ook normaal zijn geweest.
that MOD OOK usual be been
'That would have been normal.'

In the present paper, we will explore the marking that is required to establish ϕ-reference in discourses involving responses with predicates of personal taste like (6B) and (7B) in more detail. The other cases of reference to a positive proposition in the scope of negation mentioned above are beyond the scope of this paper and must be left for future research. Also, we will be mainly focusing on Dutch. The goal of the paper is twofold. First, we will present quantitative evidence supporting Meijer's claims about the influence of the presence of the MP *ook* and the past participle *geweest* on establishing ϕ-/$\neg\phi$-reference in responses like (6) (section 2). This quantitative verification is important because the judgments are somewhat subtle and sometimes puzzle native speakers. We will also see, however, that the empirical results offer some intricacies that merit some detailed discussion. Second, we will theoretically evaluate the experimental findings. For *ook* (section 4), we will largely Meijer's suggestion that the particle signals that the knowledge that is available to the speaker, already entailed the truth of the proposition that was asserted by the previous speaker before that assertion was made. Therefore, the accommodation of a CF that calls into question the truth of the utterance of the previous speaker – which is what seems to be happening with $\neg\phi$-reference – is incompatible with using the particle *ook* in that CF. With respect to the tense marking, Meijer suggests in her discussion of the occurrence of the past participle and *zouden*, that this combined marking fits a cross-linguistic pattern of establishing counterfactuality with multiple tense markers. However, she does not provide an explanation of the temporal marking in relation to the two anaphoric possibilities. Prima facie there is no obvious reason why the presence of a past participle in the consequent should result in ϕ-reference whereas the absence of that participle should re-

[3] There are instances of ϕ-reference which do not require the presence of *ook*. Consider (i) (Berry Claus, p.c.), where *ook* is not required for *dat* to refer to the proposition *Jan has won the final match*. In fact, if *ook* were present, (iB) would be slightly odd. Note that (i) is not a contextual CF, and cannot be paraphrased as one.

(i) A: Jan heeft de laatste wedstrijd niet gewonnen. $\equiv \neg\phi$
Jan has the final match not won
'Jan hasn't won the final match.'

B: Dat$_{\phi}$ zou nodig zijn geweest om deel te nemen aan de finale.
that MOD required be been to part to take on the finale
'That would have been required for taking part in the final.'

sult in $\neg\phi$-reference. In section 4 we will propose an explanation for the tense marking in the contextual CFs in (6), building on the proposal for tense in CFs by Ippolito (2013).

2. Experiment

For the quantitative verification of the empirical observations made in Meijer (2016), we conducted a semantic forced choice experiment. The experiment tested discourses which consisted of a negative assertion uttered by one speaker, and a response by another speaker that involved a predicate of personal taste. There were four types of discourses, which differed in whether or not the response contained the MP *ook* and/or the past participle *geweest*. (9) is a sample item.

(9) Willem en Elisabeth laten hun grote tuin herinrichten. Hiervoor hebben ze een tuinman ingehuurd. Ze spreken over de herinrichting van de tuin.
‘Willem and Elisabeth are having their large garden redecorated. They hired a gardener to do this. They are talking about the redecoration of their garden.’

W: De tuinman heeft het gras nog niet gezaaid.
The gardener has the grass still not sown.
‘The gardener hasn’t sown the lawn yet.’

E1: [−TENSE,−OOK] Dat zou raar zijn.
that would odd be

E2: [−TENSE,+OOK] Dat zou ook raar zijn.
that would OOK odd be

E3: [+TENSE,−OOK] Dat zou raar zijn geweest.
that would odd be been

E4: [+TENSE,+OOK] Dat zou ook raar zijn geweest.
that would OOK odd be been

The participants in the experiment were asked to choose between one of two possible interpretations for Elisabeth’s responses in (10E1-E4), such that the anaphoric pronoun *dat* was interpreted as referring to the negative proposition $\neg\phi$, *the gardener has not sown the lawn yet*, or to the positive proposition ϕ, *the gardener has sown the lawn (already)*,[4] which arguably were introduced in the utterance by Willem. As discussed in the previous section, Meijer (2016) observed that *dat* receives a ϕ-interpretation in the response in discourses like (9) if both *ook* and the past participle *geweest* are present. Therefore we expect that in condition E4, participants should choose the interpretation where *dat* refers to ϕ. In condition E1, in contrast, *dat* should not refer to ϕ because the response neither contains *ook* nor *geweest*. So participants should choose the ϕ-interpretation much less often for E1 than for E4. As for E2 and E3, Meijer

[4]The antecedent clause, uttered by the first speaker, contained the negative polarity item *nog* ‘yet’. This item cannot be part of the positive proposition, and most likely is replaced by the positive polarity counterpart *al* ‘already’ during the referential process (in a way to be explored by future research). This replacement does not seem to cause problems for anaphoric reference to positive/negative propositions: the materials used here have been adapted from earlier acceptability judgment studies on anaphoric reference involving response particles reported in Meijer, Claus, Repp and Krifka (2015) and in Claus, Meijer, Repp and Krifka (accepted), where the replacement did not seem to lead to degradedness.

(2016) observes that if only *geweest* or only *ook* are present in the response, that response is not fully coherent on the reading involving ϕ-reference. For the forced choice between the ϕ- and the $\neg\phi$-interpretation, this might either mean that participants choose randomly between these two interpretations, or that they still show a preference for one over the other. On the basis of the concrete meaning contributions that we propose for the past perfect morphology (section 3) and that Meijer proposes for *ook* (section 4), we expect for both E2 and for E3 a higher proportion of ϕ-references than for E1. For E2, there should be a very high proportion of ϕ-references – possibly as high as for E4 – because, as we will see below, $\neg\phi$-reference results in a presupposition failure for *ook*. For E3, the proportion of ϕ-references might be a bit lower because the past tense morphology is ambiguous, see section 3 for details.

2.1. Method

24 native speakers of Dutch were recruited through Prolific Academics (https://www.prolific.ac) and received payment for their participation. The experiment had a 2x2 within-subjects design with the factors OOK (+/−ook) and TENSE (+/−past participle). There were 24 experimental items and 24 fillers from another experiment. Items were allocated to participants and conditions in a Latin square design. Each item was constructed as illustrated in (9). There was a scene-setting passage that introduced the interlocutors and the topic of the conversation. One of the interlocutors made a negative assertion, the other responded such that the response was one of the four conditions illustrated in (9). The predicates of personal taste used in the materials all expressed surprise. There were twelve such predicates: *gek* 'crazy', *raar* 'odd', *vreemd* 'strange', *uitzonderlijk* 'extraordinary', *merkwaardig* 'remarkable', *opvallend* 'notable', *eigenaardig* 'peculiar', *verbazingwekkend* 'surprising', *bizar* 'bizarre', *opmerkelijk* 'remarkable', *maf* 'crazy' and *apart* 'unusual'. Each predicate was used twice. After having read the dialogue in (9), participants were given a choice between two paraphrases which were meant to reveal the ϕ- vs. $\neg\phi$-interpretation of the response, see (10). The tense marking in the clause preceding the paraphrases matched the tense marking in the response, i.e. for conditions E1 and E2 the marking was *zou* plus infinitive, and for conditions E3 and E4 it was *zou* plus *hebben* 'have' plus past participle. The antecedent paraphrases always had past perfect tense marking. We will discuss this tense marking in section 3.

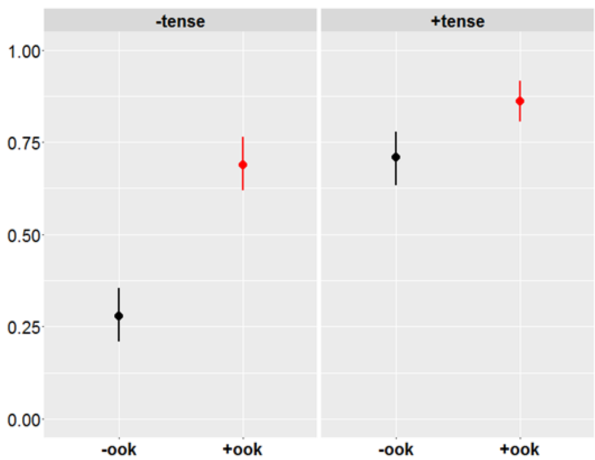
(10) Elisabeth zou het raar {vinden$_{\text{E1/2}}$/hebben gevonden$_{\text{E3/4}}$},
'Elisabeth would {find$_{\text{E1/2}}$/ have found$_{\text{E3/4}}$} it weird,'

- ◦ als the tuinman het gras nog niet had gezaaid. $\neg\phi$
  if the gardener the grass yet not had sown
  'if the gardener had not sown the lawn yet.'
- ◦ als the tuinman het gras al had gezaaid. ϕ
  if the gardener the grass already had sown
  'if the gardener had sown the lawn already.'

For half of the participants, the first proposition was $\neg\phi$; for the other half, it was ϕ. After participants had chosen one of the paraphrases, the item disappeared from the screen. A verification task followed. Participants read an assertion about the previous test item and judged its truth. Participants that scored at chance level on this task were excluded from the analysis.

2.2. Results

Figure 1 and Table 1 show the mean proportions of choice of the positive proposition, i.e. of ϕ-reference, for the four conditions in the experiment. Descriptively, we may say that the individual effects of the *ook* and *geweest* was similar (each producing around 70% ϕ-references), and that the most reliable way of establishing ϕ-reference was a combination of the two markers. If no marker was present, ϕ-reference was chosen not very often. The statistical analysis was carried out with linear mixed-effects models with a binomial logit function. The fixed factors were TENSE and OOK with contrast coding −1 for −OOK and −TENSE, and +1 for +OOK and +TENSE. Participants and items were random factors. The best models (forward selection) contained random participant slopes for OOK and random intercepts for items. The analysis revealed a main effect of TENSE (b = 2.96, SE = 0.40, t = 7.4, p < .001) and of OOK (b = 2.78, SE = 0.50, t = 5.6, p < .001). ϕ-reference was chosen more often when the past participle was present, and it was chosen more often when the MP was present. There also was an interaction of the two factors (b = −1.32, SE = 0.56, t = −24, p = .019). The effect of the participle was smaller when *ook* was present than when it was not present.



condition	proportion	sd
[−TENSE, −OOK]	.278	.449
[−TENSE, +OOK]	.688	.465
[+TENSE, −OOK]	.708	.456
[+TENSE, +OOK]	.861	.347

Table 1. The propositions of choice of the non-negative conditional clause and the standard deviation.

Figure 1. The mean proportion of choice of the non-negative conditional clause.

The experiment has shown that for ϕ-reference, speakers prefer the presence of both the past participle *geweest* and the MP *ook*. However, even if only one of these markers is present ϕ-reference is more likely than if none of these markers is present. In the following we will propose how these results can be accounted for.

3. Tense in contextual counterfactuals

The literature on CFs distinguishes between two major types of CFs: those with simple past morphology, and those with past perfect morphology, see (11a) and (b), respectively. The difference is also sometimes characterized as (11a) containing one *layer* of past morphology – in the antecedent (*be* + PAST) and in the consequent (WOLL + PAST) –, and (11b) containing two layers of past morpholgy – additional *have* in antecedent and consequent (Iatridou 2000).[5] (12) shows that the same marking is present in Dutch. The finite verb *zou* in the consequent is the 3rd person past tense of the auxiliary *zullen* 'will.INFINITIVE'.[6] Now crucially, both in English and in Dutch, the 'actual tense' in these examples, i.e. their temporal interpretation, seems to be different from what the morphological marking suggests. (11a) and (12a) seem to convey that it is not true that John is here at present and Jane is happy at present, whereas (11b) and (12b) seem to convey that it is not true at some relevant moment in the past that John was here and Jane was happy. So (11a) and (12a) are about worlds 'contrary to the present' whereas (11b) and (12b) are about worlds 'contrary to the past' (Iatridou 2000). It seems that there is one past too many both in the antecedent and in the consequent of the CFs. This 'additional' layer of past has been called *fake past* or *fake tense* (Iatridou 2000 and subsequent literature). The 'remaining' tense is the one that fits the actual temporal interpretation, i.e. present tense in (11a) and (12a) and past tense in (11b) and (12b).

(11) a. If John were here Jane would be happy.
b. If John had been here Jane would have been happy.

(12) a. Als Jan hier was, zou Anne gelukkig zijn.
if Jan here be.PAST will.PAST Anne happy be
b. Als Jan hier was geweest, zou Anne gelukkig zijn geweest.
if Jan here be.PAST been will.PAST Anne happy be been

The above observations have spurred various analyses where the fake past is assumed to trigger a CF reading either via a past interpretation or via a modal interpretation (see Schultz 2014 for a brief overview). Proposals also differ with respect to whether the fake tense outscopes the entire conditional or not. We will explore two past-as-past approaches with wide-scope fake tense here, viz. Arregui (2007) and Ippolito (2013), because these approaches address some complications that we will talk about instantly and that are relevant for the discussion of our experimental results. Terminology-wise, we will dub the tense outscoping the conditional *wide-scope* past/tense, and the tense that seems to be interpreted *in* the conditional clauses, i.e. present tense in (11a) and (12a) and past tense in (11b) and (12b), the *local* tense.

Now, an important challenge for the analysis of the local tense is the observation that the intuitions about the temporal interpretation in the above examples, although apparently clear, are

[5] We will not distinguish between present CFs and *future less vivid* (FLV) conditional sentences (cf. Iatridou 2000) here. The latter contain a telic rather than stative predicate in the antecedent, which has consequences for the interpretation of the present (future-oriented or not). We will see later that the type of predicate in general seems to play an important role in the temporal interpretation of CFs but we cannot discuss this issue in this paper.

[6] *Zullen* is traditionally characterized as a future auxiliary. Broekhuis and Verkuyl (2014) argue that *zullen* is purely modal and therefore is different from English WOLL. This debate is not immediately relevant for the present discussion. Furthermore, note that it is also possible to form a past perfect consequent without *zouden* in Dutch. In (i) the consequent contains the same morphology as the antecedent. We gloss over this here.

(i) Als Jan hier was geweest, dan was An gelukkig geweest.
if Jan here was been then was An happy been

deceptive. As was observed in Dudman (1984) and subsequent literature (e.g. Ogihara 1999; Arregui 2007, 2009; Ippolito 2003, 2013), CFs with simple past marking cannot only be about the present but also about the future, and CFs with past perfect marking cannot only be about the past but also about the present and the future, see (13) from Dudman (1984). The data are equivalent in Dutch, which for reasons of space we cannot show here.

(13) a. If Grannie missed the last bus tomorrow, she would walk home.
b. If Her Majesty had been here now, she would have been revolted.
c. If Grannie had missed the last bus on Friday (next Friday), she would have walked home. (*She is actually dead*)

Importantly for our discussion of ϕ-reference, there are restrictions on the use of the morphological tense marking for certain temporal interpretations. Observe that the set of examples we have looked at so far does not include a CF with simple past marking that has a past interpretation. The following examples illustrate that even with an elaborate context, a simple past marking in antecedent and consequent (14b), only in the consequent (14c), or only in the antecedent (14d), is unacceptable if a past interpretation of both antecedent and consequent is intended (compare (14a)). (14b) and (14c), where the antecedent is marked with simple past, are generally unacceptable with a past interpretation of the antecedent. (14d) is 'only' infelicitous with the indicated past interpretation of the consequent. If we replace *last week* in the consequent of (14d) with *now* and imagine that Paul's failure to turn up has created long-term sadness in Jane, (13d) is felicitous. Thus, it is clearly possible to combine a past perfect antecedent with a simple past consequent if the latter contains a non-past interpretation. Again, the data are parallel in Dutch.

(14) Paul had announced for last week that he would be in London. His old friend Jane was looking forward to seeing him. However, Paul didn't turn up, and Jane wasn't happy.
a. If John had visited London last week Jane would have been happy (last week).
b. *If Paul visited London last week Jane would be happy (last week).
c. *If Paul visited London last week Jane would have been happy (last week).
d. #If Paul had visited London last week Jane would be happy (last week).

The restrictions on the tense morpohology in an otherwise apparently fairly flexible tense marking system in CFs has received different kinds of analyses in the literature. As mentioned above, both Arregui (2007) and Ippolito (2013) assume that a layer of fake tense outscopes the conditional. The proposals differ with respect to the local tense in the conditional clauses (as well as with respect to the number of wide-scope past operators, see below). We will briefly describe the two proposals here.

Arregui (2007) sees the crucial difference between simple past vs. past perfect morphology as an aspectual rather than a tense difference. She suggests that simple past antecedents with eventive predicates contain a perfective operator, whereas antecedents with the past perfect (or those with a stative predicate) come with a perfect operator. The perfective operator introduces a deictic event pronoun. The deictic nature of that pronoun creates the presupposition that the respective event is true in the actual world, i.e. that it has happened.[7] For instance, in contexts like (14), the presupposition *Paul visited London* is clearly violated: Paul was not in London. So a simple past antecedent is expected to be infelicitous. A past perfect antecedent, in contrast, is felicitous because the perfect operator does not come with a deictic event pronoun.

Turning to Ippolito (2013), we need to go in a bit more detail in order to be able to discuss our findings within her theory further below. Similarly to Arregui (2004, 2009), Ippolito assumes that a CF reading arises from the presence of a past operator that takes scope over the entire conditional. This past operator binds the time argument of the accessibility function of the modal WOLL. This function returns the set of worlds that have the same history as the evaluation world up to a time *t*, the *accessibility time*. At *t*, the truth of e.g. John having visited London has not been decided yet and what is called in the philosophical literature *branching* into different futures occurs only afterwards. The wide-scope past operator shifts the accessibility time to the past, which means that the worlds started branching into different futures at a time in the past. In addition to the accessibility time, there is another time that is important in Ippolito's account. This is the reference time, which is the time when presuppositions of the antecedent and the consequent are evaluated: the presuppositions must be entailed by the worlds that are historically accessible from the reference time. Since the set of possible worlds can only become smaller over time, and because the reference time cannot precede the accessibility time, the presuppositions eventually must be satisfied *at* the reference time. The default reference time is the utterance time. For illustration Ippolito discusses the following example. For someone to be in love they must be alive (cf. Musan 1997 for existence presuppositions of this kind). So, a presupposition of the antecedent in *If John were in love with Mary, he would ask her to marry him* is that John is alive in worlds that are historically accessible from the utterance time, and thus by extension at the utterance time. As a consequence, the utterance of this conditional after a statement like *John is dead* is infelicitous. However, if the same conditional appears with past perfect marking it is felicitous in this context. According to Ippolito, this effect is due to the past perfect introducing a second past tense operator that scopes over the entire conditional. The function of this operator is to shift the reference time to the past. As a consequence, the presuppositions of antecedent/consequent are evaluated for worlds that are historically accessible from a reference time that is before the utterance time. With respect to the example we just discussed, this means that the being-alive presupposition must be entailed by historically accessible worlds at that past reference time. Since there is a time in the past where worlds with a living John are still accessible the CF *If John had been in love with Mary, he would have asked to marry him* is felicitous if John is dead at the utterance time.

Now, in addition to the two wide-scope past operators, Ippolito assumes that the antecedent and the consequent each have 'local' deictic tense, which is always evaluated with respect to the utterance time. Such local deictic tenses are also assumed e.g. by Romero (2014). What is special about Ippolito's account is that the present perfect – due to a deficit in English morphology – may either signal the presence of the two wide-scope operators that we discussed, or the presence of the two wide-scope operators *plus* the presence of local past tense. The mor-

[7] See Arregui (2007: 247ff.) for cases where the speaker does not or cannot know whether the event has happened / will have happened.

phological deficit is that standard English does not have the morphology to express three layers of past. Therefore, Ippolito proposes the following structures for CFs:

(15) Simple past (a) and past perfect (b&c) CFs (Ippolito 2013: 96ff.)

a. [PAST$_1$[WOLL [PRESENT$_{deictic}$ ϕ] [PRESENT$_{deictic}$ ψ]]]
b. [PAST$_1$[PAST$_2$ [WOLL [PRESENT$_{deictic}$ ϕ] [PRESENT$_{deictic}$ ψ]]]
c. [PAST$_1$[PAST$_2$ [WOLL [PAST$_{deictic}$ ϕ] [PAST$_{deictic}$ ψ]]]]

In (15a) and (b), there is a deictic present tense in the antecedent and in the consequent of the conditional. This structure is not compatible with the examples in (14) above, because these all involve the adverb *last week*. The present tense indicates that we are evaluating an event that would have taken place now which is inconsistent with *last week*. Therefore, we must assume that the examples in (14) have the structure in (15c). A question that arises is how we can account for the felicitous minimal variant of (14d) in which we replaced *last week* in the consequent with *now*. According to Ippolito's structures in (15b) and (c), there would still be two past tense operators outscoping the entire conditional, because the antecedent occurs in the past perfect. Yet, intuitively, using a past perfect rather than a simple past in the consequent alters the interpretation of the conditional. At this point, we do not see how Ippolito's account can be altered, such that it can account for such 'mixed' CFs.

With this much in hand, let us now turn to our cases of ϕ-reference / $\neg\phi$-reference in the experiment presented in section 2. Recall that the utterance of the first speaker in our discourses is a negative assertion stating that a certain event (e.g. one of the gardener sowing the lawn) has not taken place. We are assuming that this assertion is one about the past, which is the default interpretation of the present perfect in Dutch (Broekhuis and Verkuyl 2014).[8] Next, recall that we are assuming that the second speaker, who uses a contextual CF to evaluate the utterance of the first speaker, plausibly accommodates either the past perfect CF in (16Bϕ) or the one in (16B$\neg\phi$).

(16) A: The gardener hasn't sown the lawn yet.
B: Dat zou (ook) raar zijn (geweest), ...
that will.PAST OOK odd be been
ϕ ... als de tuinman het gras al had gezaaid.
... if the gardener the grass already have.PAST sow.PERF
$\neg\phi$ ... als de tuinman het gras nog niet had gezaaid.
... if the gardener the grass not yet have.PAST sow.PERF
'It would {be / have been} strange if the gardener had(n't) sown the lawn {yet / already}'

[8]There are differences between the Dutch present perfect and the English simple past but note that the Dutch present perfect can be used in sentences that contain a temporal modifier like *yesterday*, which is not possible with the English present perfect: **John has gone to the cinema yesterday* vs. *John went to the cinema yesterday*. A thorough discussion of this issue is beyond the scope of this paper; we refer the reader to De Vuyst (1985).

Starting with the tense in the antecedent, recall from the introductory section that when accommodating a CF like the one in (16Bϕ) the second speaker accepts what the first speaker said as true. In the actual world, the gardener hasn't sown the lawn, in the CF worlds he has sown the lawn. In Ippolito's terms, the CF worlds are historically accessible only from a reference time in the past, at which it was still possible for the gardener to sow the lawn. Therefore, there must be two past operators scoping over the conditional. As a consequence, the conditional antecedent in (16Bϕ) must be marked with the past perfect. This is the tense morphology that we used in the paraphrases in the experiment for ϕ-reference. On Arregui's account we expect past perfect marking as well because that marking comes with no presupposition concerning the actual existence of the event at issue – which is what is required in the above context: the context says that the event did not take place. Further below – when we discuss the tense marking in the consequent, which we argue can be captured best in Ippolito's account – we will suggest that the local deictic tense in the antecedent of (16Bϕ) is past tense as well.

As for (16B$\neg\phi$), we said in the introductory section that the second speaker doubts what the first speaker said, viz. that the gardener hasn't sown the lawn. The second speaker implicates that the gardener has sown the lawn. What is interesting about this kind of CF is that intuitively, the present perfect marking in the antecedent of the conditional also seems to be allowed. That is the sentence that is uttered by the first speaker can form the antecedent of the contextual CF. In English, this would look as follows: *A: John did not work. B: If John didn't work....* Note that the preferred interpretation of the antecedent seems to be that of an antecedent in an indicative conditional. Thus, such a marking somehow reduces the 'degree' of counterfactuality of the sentence. An antecedent with past perfect marking seems to be better suited to express stronger counterfactuality (cf. Iatridou 2000; Ippolito 2013). For the present purposes we need to lay that issue aside. In the experiment, we chose past perfect marking for the antecedent of the paraphrases that we gave to the participants both for ϕ-reference and for $\neg\phi$-reference because this choice enabled us to compare minimal pairs in the investigation of the tense marking in the consequent.

Turning to the tense in the consequent, the experiment revealed that morphological marking with the past perfect increased the chances that the demonstrative pronoun in the response was interpreted as having ϕ-reference. As we saw above, the consequent of a CF with a past perfect antecedent in principle can occur with simple past marking or with past perfect marking, if the antecedent is overt. So in principle the choice of tense for the consequent is open.[9]

[9] Also observe that the choice between present perfect and past perfect does not seem to influence nominal reference under modal subordination, at least in examples like (iA). The indefinite *een dier* 'an animal', which occurs under negation in the first utterance, is felicitously picked up by the pronoun *het* 'it' in the second utterance, independently of the morphological marking in that utterance, which corresponds to the consequent in an accommodated CF.

(i) Context: Paul gaat af en toe vroeg in de ochtend jagen. Rond het middaguur vraagt Anna, die Paul die dag nog niet gezien heeft, zich af of hij vanochtend heeft gejaagd.
'Every now and then Paul goes hunting early in the morning. Around noon, Anna, who hasn't seen Paul today yet, is wondering if he was out hunting this morning.'

A: Paul heeft geen dier$_i$ geschoten. Het$_i$ zou daar in de hoek {liggen /hebben gelegen}.
Paul has NEG+a animal shot it would there in the corner lie /have lain
'Paul has not shot an animal. It would {be/have been} lying in the corner over there.'

Let us see how the accounts by Arregui (2007) and Ippolito (2013) can be applied to our findings about the consequent. Arregui (2007) designed her proposal for the antecedent in CFs but observes in a footnote (p. 224, n. 2) that the tense restrictions that she discusses for antecedents are essentially the same for consequents. She suggests that the latter also fit the proposal she makes but does not discuss any details. As we briefly mentioned above, a crucial question within Arregui's aspectual account is whether the consequent is eventive or stative. For eventives, the tense matters because they combine with the deictic event pronoun that is introduced by the perfective aspect. For statives, the tense does not matter because there is no event pronoun. The evaluating consequents in our examples, see (20), are stative. So tense should not matter. However, our experimental results seem to suggest it does. This is problematic for Arregui's account and we do not see a straightforward way of fixing the problem.

As we saw above, Ippolito (2013) assumes that there local tense in the antecedent and in the consequent of conditionals that receives a deictic interpretation. However, she also points out that it is not quite clear how the tense marking in the consequent can be related to the wide scope past operator(s), whose presence is signaled by the past perfect morphology in the antecedent, and which, as we saw above, we must assume is present in our discourses. Ippolito discusses a potential sequence-of-tense analysis (also cf. Romero 2014) for past perfect marking in the antecedent and the consequent. However, as we mentioned above, she does not consider 'mixed' CFs, i.e. CFs with a past perfect antecedent and with a simple past consequent in English (which would correspond to the present perfect in Dutch). To explain the results that we obtained in the experiment within Ippolito's proposal we will capitalize on the idea that the local tenses are interpreted deictically. Let us start with the preferred preference of the past participle for ϕ-reference. Recall that our contextual CFs are responses to a negated assertion about the past. This assertion thus introduces a salient time in the past. It is a plausible to assume that a subsequent contextual CF will say something about this salient time. Thus, we assume that the consequent conveys that the speaker thinks that the worlds that are picked up by the propositional anaphor contain spatio-temporal regions that are specified for that salient time in the past, are strange – or rather *were* strange, because they are in the past. It is not very plausible to assume that the strangeness only applies at the time of speaking, which is what the absence of the past participle would signal.

Turning to the $\neg\phi$-reference, it seems that we may say exactly the same: the contextual CF is a response to a negative assertion about the past. As a consequence we might expect the presence of a past participle. However, recall that the CFs that are arguably accommodated in the two cases are different. In the case of $\neg\phi$-reference, the speaker doubts the truth of the previous utterance. So, the evaluative comment refers to the truth of the utterance just made rather than to past CF worlds on whose counterfactuality both speakers agree as in the case of ϕ-reference. Since the truth of the utterance is at issue at the utterance time, the consequent preferably is marked without the past participle.

Linking these suggestions to Ippolito's structures for CFs in (15), we might say that ϕ-reference has the structure in (15c). Both the antecedent and the consequent contain a local deictic past, with the entire conditional being in the scope of the two past operators that we argued for above. $\neg\phi$-reference cannot straightforwardly be matched to Ippolito's structures because there seem to be different tenses in antecedent and consequent. Also, recall that the details of the interpretation of such doubting CFs still pose a number of questions that need to be addressed in future research.

With respect to the experimental results, the above suggestions explain why the presence of the past participle increases the proportions of ϕ-reference. Still, recall that in condition E3, which contained a past participle but not the MP, there still was a non-negligible proportion of $\neg\phi$-choices. We may assume that speakers adopted a structure like (15b) when they made this choice. According to Ippolito past perfect marking is compatible with a local present tense interpretation: the past perfect may signal the presence of only the two wide scope past operators. An alternative, or additional explanation for the results for E3 might be that the contextual CFs with ϕ-reference have a kind of default marking, which includes the MP *ook*. The experimental results suggest that this might indeed be the case because ϕ-choices were most frequent if both the participle and the particle were present (condition E4). Hence, if one of the 'typical' markers is missing, slight incoherence might arise, which most likely influences the way participants interpreted the response. This issue needs to be investigated in future research in an acceptability study. Finally, recall that the proportion of ϕ-choices was non-negligible when the past participle (and the MP *ook*) was absent (condition E1). Again, it is possible that some speakers do not find such utterances coherent (as is the case for German, see footnote 2). As a consequence they might have found it difficult to determine the meaning of the response. This issue also needs to be investigated in an acceptability study.

4. The MP *ook*

In this section we will discuss the finding that the presence of the MP *ook* increased the proportion of ϕ-references. We will generally follow the proposal by Meijer (2016) but deviate in some of the details. Meijer builds her analysis – which she provides for *ook* and its German cousin *auch* – on previous accounts of the German particle because descriptions of Dutch *ook* are scarce. We will employ the same strategy in our initial characterization of the particle but then focus on *ook*.[10] (17) shows an example of the MP *ook*. Speaker A notes that Peter

[10]Note that *ook* (as well as *auch*) is ambiguous between a MP and an additive focus particle reading. As a focus particle *ook* comes in two variants: unstressed and stressed. If it is unstressed it associates with a focus in its c-command domain, see (i). If it is stressed it associates with a focus that is outside its c-command domain, see (ii). Both variants come with the presupposition that there is an alternative in the context for which the predicate that holds for the focus constituent also holds for the alternative. Thus, in (i) and (ii) there must be someone in addition to Marie that Peter called. There are subtle differences between the two versions of the particle, see e.g. Krifka (1998) and Reis and Rosengren (1997) for analyses of stressed German *auch*.

(i) Peter heeft ook MARIE gebeld.
Peter has OOK Marie called
'Peter has also called Mary.'

(ii) Peter heeft MARIE OOK gebeld.
Peter has Marie OOK called
'Peter has also called Mary.'

Focus particle(s) and the MP can be distinguished from each other by their prosody (the MP cannot be stressed) and their syntactic distribution. Most importantly for the present purposes, the focus particles but not the MP come with the above-mentioned presupposition. Our experimental materials (recall (9) in section 2) were such that that presupposition was not satisfied in the context. Neither did the scene-setting passage provide a focus alternative to *dat* (which would have been required for the stressed variant of *ook*), nor did it provide a focus looks bad. Speaker B's response is to be read as conveying that Peter's looking bad was not unexpected to him, since Peter has been ill for a long time (cf. Karagjosova 2003 for *auch*).

(17) A: Peter ziet er slecht uit.
Peter looks there bad out
'Peter looks bad.'
B: Hij is ook lang ziek geweest.
he is OOK long ill been
'Well, he has been ill for a long time.'

Auch has been claimed to indicate that a previously asserted proposition was expected to be true already (Thurmair 1989, Karagjosova 2003). As a consequence, with an *auch*-utterance, a speaker confirms the proposition asserted prior to the *auch*-utterance. Karajogosova (2003) notes that *auch*-utterances can be 'corrective', in the sense that speakers can use them to indicate to their interlocutor that the previous utterance did not even contain new information. Furthermore, she suggests that *auch* signals that the speaker has made some sort of inference, based on what s/he already knew (for instance, from Peter being ill for a long time, we can infer that he looks bad). She notes that *auch*-utterances often can be translated with *because*-constructions (e.g. *Peter looks bad because he has been ill for a long time* for (17B)). However, note that it is not actually possible to paraphrase contextual CFs using *because*, as the use of *auch* does not seem to be causal here. In line with this intuition, Bergmann and Repp (2015) provide experimental evidence suggesting that *auch* is not causal in the same way that the e.g. German markers *denn* 'because' and *eben* 'obviously' are. A recall experiment showed that *denn* and *eben* helped recalling information. This effect was not found for *auch*. Yet, the recall of information has been claimed to be aided by the presence of causal markers (e.g. Caron, Micko and Thüring 1988).

Meijer (2016) largely follows the theories by Thurmair (1989) and Karagjosva (2003), but offers a formal analysis of *auch* and *ook* as epistemic markers. Roughly, Meijer suggests that *auch/ook* presupposes that the proposition asserted in the previous utterance (proposition ϕ_{-1}) was already entailed by the epistemic modal base before it was asserted, as shown in (18). The epistemic modal base $f(w)$ contains the propositions that describe the knowledge that has been established in a world w (Kratzer 1981).

(18) $[\![\mathbf{ook}(\phi)]\!]^{c,w} = \phi$; defined if $\cap f(w) \subseteq \phi_{-1}$ before ϕ_{-1} was uttered

Applying (18) to (17), we can say that the knowledge available to B enabled him to infer that Peter was looking bad, before A asserted this. Specifically, B's world knowledge that *if one is ill for a long time, one looks bad* and the knowledge that Peter has been ill for a long time most likely are decisive here. Note that the dialog in (17) is still fine if A knows nothing about Peter's medical history, but does know that he looks bad. The fact that for A, the proposition that Peter looks bad does not have to be inferable in the way that *ook* signals that it is for B,

alternative to *(to be) strange* (which would have been required for the unstressed variant of *ook*). Furthermore, it is difficult to accommodate the presupposition of additive focus particles (Kripke 2009). Hence, we assume that it is highly unlikely that the participants in the experiment interpreted the word *ook* as a focus particle.

shows us that it need not be the context set that is the contextually salient body of knowledge, but it could also be the knowledge of the speaker.[11] However, in what Karagjosova calls the ‘corrective’ use of *auch*, it seems that the particle indicates that the speaker who is making the *auch*-utterance indicates to his/her interlocutor that s/he should have known already that this proposition was inferable. In such scenarios, it might be the context set that is the relevant body of information.

Meijer’s (2016) specific proposal for *auch* and *ook* is slightly different from what we are assuming here. It is couched in the framework by von Fintel and Gillies (2010) on *must*, where a distinction is made between two sets of propositions that are relevant for epistemic/evidential modality. The first set is the kernel. This set consists of propositions that the speaker takes to be true (propositions denoting world knowledge, direct observations and trustworthy knowledge). The second set is the intersection of the kernel: the modal base it determines. For *must*, roughly, the authors argue that it presupposes that its prejacent is entailed by the modal base that the kernel determines but that it is *not* in the Kernel. Meijer (2016) tentatively suggests that the MPs signal that the prejacent was entailed by the modal base, but remains agnostic about the presupposition *auch*/*ook* bear with respect to the kernel. For *ook*, Meijer points out that the kernel does not seem to play a role, since (17B) is felicitous, even if both speakers have seen that Peter looks bad and are aware of their mutual knowledge. For some speakers of German, the use of *auch* in such scenarios is marked, which suggests that for these speakers, the prejacent of *auch* cannot be in the kernel. Meijer (2016) therefore remains agnostic with respect to the role of the kernel in uses of *auch*. Since the kernel does not seem relevant for *ook*, we will stick to (18) and leave research into the use of *auch* in scenarios in which the prejacent is in the kernel for future research.[12]

Let us return to the use of *ook* in contextual CFs and to our experimental results. From the above suggestion for *ook*, it follows that if *ook* is used in response to a negative assertion the utterance that *ook* occurs in is interpreted as affirming this negative assertion. Such an affirmation is present in the CFs with ϕ-reference but not in the CFs with $\neg\phi$-reference. Recall that in the latter the second speaker doubts what the first speaker said, viz. that $\neg\phi$ is true. Hence, we predict that *ook* should not be felicitous with $\neg\phi$-reference. With respect to our experiment, this means that conditions with *ook* (E2, E4) should elicit a low proportion of $\neg\phi$-choices. This is what we found. However, recall that there still was a non-negligible proportion proportion of choices for $\neg\phi$ for contextual CFs that contain *ook*, but not *geweest* (E2). As we pointed out above, the most common, or preferred, way of establishing ϕ-reference in contextual CFs is by including both the MP and the past participle. As we mentioned in the discussion on *geweest*, it could be that the lack of one of these markers made the response incoherent for some of the participants. Future research should investigate this matter in an acceptability judgment study.

[11]We are aware that some authors have argued against such an analysis of modal verbs (e.g. von Fintel and Gillies 2008) and we do not wish to enter this debate on modality. However, for the use of *ook* the data strongly suggest that it is the knowledge of the speaker that is relevant for a felicitous use of the MP.

[12]It seems that (18) holds too for those speakers of German who think that the German equivalent of (17) is fine even if both speakers are aware of their mutual knowledge of A’s assertion before A made this assertion.

5. Conclusion

In this paper we have argued that two important factors for establishing reference to a proposition in the scope of a negation in a previous utterance are the tense marking and the presence or absence of the MP *ook* (cf. Meijer 2016). We have provided experimental evidence for a certain class of evaluative utterances that supports this empirical claim. With Meijer (2016) we have assumed that these evaluative utterances are contextual CFs for which an antecedent is accommodated on the basis of the previous utterance. The antecedent that is accommodated either contains a negation or not, and it serves as the antecedent for the propositional anaphor in the consequent, i.e. decides whether the anaphor refers to the proposition in the scope of the negation ϕ or the negated proposition $\neg\phi$. With Meijer (2016) we have argued that *ook* presupposes that the previous utterance could be inferred from previous knowledge and thus must be true. Since this presupposition is only satisfied in CFs with ϕ-reference, the presence of *ook* is only compatible with such a reading. Furthermore, we have argued that ϕ-reference is preferably marked with a past participle in the consequent because a local deictic past tense – which plausibly is the temporal interpretation of the consequent – requires past perfect tense morphology (Ippolito 2013). $\neg\phi$-reference in contrast, is compatible with a local deictic present tense in the consequent.

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The proper treatment of the wide scope *or* reading of the English *either* … *or* … construction[1]

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Abstract. The main concern of this paper is the availability of the wide scope *or* reading in the English *either* … *or* … construction and its interaction with the behavior of *either*. I propose that a hybrid analysis consisting of an ellipsis analysis (Schwarz, 1999), which directly arises from the requirement of *or* that it connect disjuncts of the same type, and a choice function analysis of *either* (cf. Winter (2001); Schlenker (2006) for a choice function analysis of *or*) explains the whole data set. I also discuss a prediction the present analysis makes and some remaining issues, including a data issue in which the judgments made by my informants differ from the ones observed in a previous study.

Keywords: disjunction, wide scope *or* reading, choice function, ellipsis.

1. Introduction

This paper focuses on the English *either* … *or* … construction, in which *either* can be overt or covert as presented in Larson (1985):

(1) a. Mary is looking for a maid or a cook.
 b. Mary is looking for either a maid or a cook. (Larson, 1985: 218)

The proposal of this paper is that a hybrid analysis consisting of a choice function analysis of *either* (cf.Winter (2001); Schlenker (2006) for a choice function analysis of *or*) and an ellipsis analysis (Schwarz, 1999) straightforwardly explains the basic data concerning the (un)availability of the wide scope *or* reading.

The rest of the paper is organized as follows. In Section 2, I review the basic data set of the availability of the wide scope *or* reading and its interaction with *either*. The main proposal is given in Section 3, where it is shown that neither a pure ellipsis analysis nor a pure choice function analysis explains the data set in Section 2. I propose that a hybrid analysis which combines the ellipsis analysis and a choice function analysis of *either*, a modified version of the choice function analysis of disjunction, covers the whole data set introduced in Section 2. Section 4 concludes the paper and discusses some potential problems related to the predictions that the present analysis makes.

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2. The basic data set

As noted in Partee and Rooth (1983) as a problematic case and discussed in Rooth and Partee (1982) in more detail, when disjunction is combined with certain kinds of elements in a sentence, the sentence is (at least) three-ways ambiguous:

(2) The department is looking for a phonologist or a phonetician. (Partee and Rooth, 1983: 374)
  a. $[\![\text{look for}]\!]([\![\text{a phonologist or a phonetician}]\!])$ (d) (narrow scope *or de dicto* reading)
  b. $\exists x : [\![\text{a phonologist or a phonetician}]\!](x), [\![\text{look for}]\!]$ (x) (d) (*de re* reading)
  c. $[\![\text{look for}]\!]([\![\text{a phonologist}]\!])$ (d) $\vee$ $[\![\text{look for}]\!]([\![\text{a phonetician}]\!])$ (d) (wide scope *or de dicto* reading)

There is a *de re* reading in (2b) according to which there is a specific person x who is either a phonologist or a phonetician, and the department is looking for him. (Since this reading does not affect the discussion in this paper, I disregard this reading hereafter.) The narrow scope *or de dicto* reading (the NS reading) is in (2a), and under this reading the department would be satisfied by finding either a phonologist or a phonetician. The "problematic" *de dicto* reading, which I am interested in, is described in (2c). On this reading, the department do not yet necessarily have a specific candidate in mind. They do already have in mind which of the two specialists they are going to look for, but the speaker forgot which it was. The reading becomes clearer when continued with "… but I don't know which." Thus the overall meaning is as if the disjunction is connecting two propositions, taking widest scope, even though the indefinite in each disjunct takes narrow scope. This is called the "wide scope *or*" reading (the WS reading) in Rooth and Partee (1982).

Larson (1985) observes that the possible readings of a sentence change when *either* comes into the structure. He states a generalization:

(3) Larson's (1985) generalization (Winter, 2000: 395):
  a. In *or* coordinations without *either*, as well as in *either* … *or* … coordinations with *either* undisplaced, the scope of *or* is confined to those positions where *either* can potentially appear.
  b. When *either* is displaced it specifies the scope of *or* to be at that displaced position.

Thus, while when *either* is adjacent to the Disjunction Phrase both NS and WS readings are available (4), when *either* floats to a higher position the NS reading disappears (5).

(4) a. Mary is looking for a maid or a cook.
  b. Mary is looking for either a maid or a cook.
    (i) $[\![\text{look for}]\!]([\![\text{a maid or a cook}]\!])(m)$ (NS reading)
    (ii) $[\![\text{look for}]\!]([\![\text{a maid}]\!])(m) \vee [\![\text{look for}]\!]([\![\text{a cook}]\!])(m)$ (WS reading)

(5) a. Mary is either looking for a maid or a cook.
  b. Mary either is looking for a maid or a cook.

c. Either Mary is looking for a maid or a cook.
(i) ?*⟦look for⟧(⟦a maid or a cook⟧) (m) (NS reading)
(ii) ⟦look for⟧(⟦a maid⟧)(m) ∨ ⟦look for⟧(⟦a cook⟧) (m) (WS reading)

Winter (2000) and Schlenker (2006) report data which at first glance look like an exception to Larson's (1985) generalization in (3), where disjunction can take wide scope over an island as in (6) and (9) but *either* cannot appear out of the island as in (8) and (11).[2] Note that *either* can appear inside the island and the disjunction can take either the narrow or wide scope as shown in (7) and (10).

(6) If Bill praises Mary or Sue then John will be happy. (Winter, 2000: 403)
a. If Bill praises Mary then John will be happy and if Bill praises Sue then John will be happy. (NS)
b. If Bill praises Mary then John will be happy or if Bill praises Sue then John will be happy. (WS)

(7) a. If Bill praises either Mary or Sue then John will be happy. (^{OK} NS / ^{OK}WS)
b. If Bill either praises Mary or Sue then John will be happy. (^{OK} NS / ^{OK}WS)

(8) *Either if Bill praises Mary or Sue then John will be happy. (Winter, 2000: 403)

(9) Students taking the exam have a choice of two options: Greek or Latin.
a. Not a single student who picked some/a certain option (I don't remember which) passed the exam. (baseline; island-escaping indefinites)
b. #Not a single student who picked at least one option (I don't remember which) passed the exam. (baseline; non-island-escaping indefinites)
c. Not a single student who picked Greek or Latin (I don't remember which) passed the exam.

(10) a. Not a single student who picked either Greek or Latin (I don't remember which) passed the exam.
b. ?Not a single student who either picked Greek or Latin (I don't remember which) passed the exam.

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[2]Larson, 1985: 245 reports that the scope of *or* actually is sensitive to CNP islands and *Wh* islands when *either* is not present as in (i) and (ii) (according to his claim, movement of the null operator in the position of *either* is sensitive to islands). Thus there seems to be a discrepancy in judgment.

(i) John maintains the claim that Bill should resign or retire.
a. John maintains [SHOULD (resign (b)) ∨ SHOULD (retire (b))]
b. *John maintains [SHOULD (resign (b))] ∨ John maintains [SHOULD (retire (b))]

(ii) John knows who should resign or retire.
a. John knows *p*, where *p* is true & ∃x [*p* = SHOULD (resign (x)) ∨ SHOULD (retire (x))]
b. ??[John knows *p*] ∨ [John knows *q*], where *p* is true & ∃x [*p* = SHOULD (resign (x))], and where *q* is true & ∃x [*q* = SHOULD (retire (x))]

(11) *Either not a single student who picked Greek or Latin passed the exam. (Schlenker, 2006: 306)

The fact that sentences with *either* inside an island do have WS readings ((7), (10)) conforms to the generalization in (3a), since sentences with *either* in its base position can have the scope of *or* higher than the surface position of *either*. In contrast, it goes against the generalization in (3b), since floated *either* does not mark the exact scope of *or* but allows the scope of *or* to be in a higher position.

In this section we have seen Larson's (1985) generalization in (3), in which it is stated that (i) in sentences with no *either* or with *either* in its base position, *or* can take both the narrow scope and the wide scope, while (ii) in sentences with floated *either*, only the WS reading is available. We have also seen data reported by Winter (2000) and Schlenker (2006), in which *or* can take scope over an island but *either* cannot overtly appear outside the island. In the next section, we will see that a hybrid analysis, which combines Schwarz's (1999) ellipsis analysis and a version of a choice function analysis that slightly modifies a choice function analysis for disjunction suggested in previous studies, explains the data in this section neatly.

3. Proposal: A hybrid analaysis

In this section, I introduce two previous analyses on the *either ... or ...* construction: the ellipsis analysis (Schwarz, 1999) and the choice function analysis of *or* (Winter, 2001; Schlenker, 2006). It is shown that although both analyses have advantages, they also have problems. I propose that the hybrid analysis which combines the two analyses with some modification covers the data set introduced in Section 2: (i) the ellipsis treatment of disjunction, which comes from the semantic requirement on *or* that it has to take two disjuncts of the same semantic type, explains the obligatory WS reading of the "floated *either*" sentences in (5), and (ii) the choice function analysis of *either*, which is a modified version of the choice function analysis of *or*, explains the ambiguity of sentences with no *either* or with *either* in its base position (4).

3.1. The ellipsis analysis

The ellipsis analysis of Schwarz (1999) claims that "unbalanced disjunction" as in (12), in which in the surface form the disjuncts are not the same size under the assumption that the overt position of *either* marks the left edge of the first disjunct, is derived by ellipsis. The analysis correctly predicts that when *either* floats only the WS reading is available, since the underlying form involves balanced disjunction and directly corresponds to the WS reading.

(12) a. John either ate rice or beans.
John either [$_{\text{VP}}$ ate rice] or [$_{\text{VP}}$ ~~ate~~ beans]
b. Either John ate rice or beans.
Either [$_{\text{IP}}$ John ate rice] or [$_{\text{IP}}$ ~~John ate~~ beans] (Schwarz, 1999: 351-352)

The ellipsis analysis can also explain the fact that the size of the second disjunct can be smaller than the first one (13a) while the size of the first disjunct cannot be smaller than the second one (13b).

(13) a. *either [X_t or Y_τ] (where τ is any semantic type)*
Mary is either looking for a maid or a cook.
Mary either is looking for a maid or a cook.
Either Mary is looking for a maid or a cook.
b. *either [X_t or Y_τ] (where $\tau \neq t$)*
#Mary is either a maid or looking for a cook.
$*$John either Mary or saw Sue.

The ellipsis analysis is able to handle this fact since ellipsis is sensitive to the linear order of the elements under consideration. Specifically, ellipsis is applied to the second (non-initial) element, under identity of the deleted element with the initial element. Thus when the size of the second disjunct is smaller than the first one (13a), it is possible to assume that there is some elided material for the second disjunct, while when the size of the first disjunct is smaller than the second one (13b), we cannot claim that the first disjunct has undergone ellipsis, since ellipsis cannot be applied to the initial element. We successfully account for the difference in the acceptability between (13a) and (13b).[3]

Next, let me closely examine the nature of the ellipsis operation that is involved in deriving unbalanced disjunction. Specifically, I will examine whether the proposal can explain data beyond the simplest ones like (12), namely sentences such as (13).

(14) John either cited a theory that Partee or Rooth invented.

(14) is an example of unbalanced disjunction which involves a Complex NP Island. According to the ellipsis analysis, its structure is as in (15), based on the assumption that unbalanced disjunction has a balanced structure in its underlying form. The surface form in (14) is derived by (i) eliding the embedded verb in the first disjunct and (ii) eliding everything but the embedded subject and verb in the second disjunct, as shown in (15). In the rest of this subsection, I investigate whether such a derivation is really possible.

(15) John either [cited a theory that Partee ~~invented~~] or [~~cited a theory that~~ Rooth invented].

[3]Note that the ellipsis analysis have difficulty in accounting for the data of "R-*either*" in Den Dikken (2006), in which *either* seems to be "buried" inside the first disjunct.

(i) John either ate rice or he ate beans. (Den Dikken, 2006: 690)

Larson (1985), who proposes a movement analysis of *either*, claims that sentences like (iia) involve an unbalanced disjunction of VP and CP as in (iib). The matrix subject moves out from the first disjunct and *either*, originally inside the DisjP, optionally moves leftwards.

(ii) a. Mary either is driving to the airport or she is taking a cab.
b. Mary$_j$ either$_i$ is [$_{\text{DisjP}}$ t$_i$ or [$_{\text{VP}}$ t$_j$ driving to the airport] [$_{\text{CP}}$ she is taking a cab]].

Going back to the original argument of the ellipsis analysis proposed by Schwarz (1999), Schwarz (1999) claims that the ellipsis operation involved in the derivation of unbalanced disjunction (17) is in fact Gapping (16).

(16) Tom has a pistol and Dick ~~has~~ a sword.

(17) a. John either ate rice or ~~ate~~ beans.
b. Either John ate rice or ~~John ate~~ beans. (Schwarz, 1999: 351-352)

As supporting evidence, he observes that Gapping and unbalanced disjunction behave similarly. For one thing, Gapping always targets the finite verb of the second conjunct, and sometimes extra material too, including subjects as in (18). This parallels the unbalanced disjunction data in (17).

(18) On Monday I bought a car and on Tuesday ~~I bought~~ a motorcycle. (Schwarz, 1999: 354)

For another, it is possible for Gapping to leave only one expression as in (19). This behavior also parallels (17).

(19) John bought a book yesterday, and a newspaper. (Schwarz, 1999: 354)

An important characteristic that Gapping and unbalanced disjunction have in common is that neither of them allows “dangling remnants,” where the first and second conjuncts/disjuncts are not parallel. In both (20) and (21), the second conjunct/disjunct has some extra material that the first conjunct/disjunct does not, and this leads to the degraded status of the sentences.

(20) *Some talked about politics and others ~~talked~~ with me about music.
(Schwarz, 1999: 356)

(21) a. ?Either [he invited you] or [~~he invited~~ me to a party].
b. ??Either [this pissed Bill] or [~~this pissed~~ Sue off]. (Schwarz, 1999: 357)

According to Schwarz (1999), the reason why the sentences in (21) are less degraded than (20) is because what is prohibited from being left as a “dangling remnant” can be Right Node Raised from both the first disjunct and the second disjunct. Right Node Raising must take place in a disjunct-final position as in (21), thus having no ameliorating effect on (20) since the “dangling remnant” there is in a medial position.

Now let us return to (14) and see whether the derivation (15) is a possible one.

(14) John either cited a theory that Partee or Rooth invented.
(15) John either [cited a theory that Partee ~~invented~~] or [~~cited a theory that~~ Rooth invented].

As stated earlier, the surface form in (14) is derived by (i) eliding the embedded verb in the first disjunct and (ii) eliding everything but the embedded subject and verb in the second disjunct, as shown in (15). The second step, namely the deletion of elements in the second disjunct, can be explained with Gapping, given that Gapping can potentially leave only one element as in (19) and, in addition, the least embedded verb can potentially be the only material elided. In fact, as laid out in Johnson (2006) in detail, Gapping cannot target an embedded verb excluding the matrix verb as in (22), following the No Embedding Constraint (23).

(22) *Alfonse stole the emeralds, and I think that Mugsy ~~stole~~ the pearls. (Johnson, 2006: 412)

(23) The No Embedding Constraint (Johnson, 2006: 412)
Let A and B be conjoined or disjoined phrases, and β be the string elided in B whose antecedent is α in A. Then α and β must contain the highest verb in A and B.

The first step of deriving (14), namely eliding the embedded verb in the first disjunct, is also accounted for by claiming that the embedded verb, which is the rightmost element in the first disjunct, undergoes Right Node Raising. The claim is consistent with the observation that Right Node Raising has to target the conjunct/disjunct-final element as in (21). Furthermore, the data conform to the classic claim that Right Node Raising has to target constituents (cf. Postal (1974); Bresnan (1974) among others), which is shown by the contrast between (24a) and (24b). As can be observed from the difference in acceptability between (24a,b) and (25c), the elided material in the first disjunct in unbalanced disjunction also has to form a constituent as in (24a,b) and the sentence is degraded when it is not a constituent as in (25c).

(24) a. He tried to persuade them, but he couldn't convince them, that he was right.
b. *He tried to persuade, but he couldn't convince, {them / the students} that he was right. (Bresnan, 1974: 615)

(25) a. John either thinks that Mary talked yesterday ~~with Sue~~ or ~~thinks that Mary talked~~ today with Sue.
b. John either thinks that Mary talked yesterday ~~about music~~ or today about music.
c. ??John either thinks that Mary talked yesterday ~~with Sue about music~~ or today with Sue about music.

Now it has been shown that the ellipsis analysis of unbalanced disjunction, claimed to involve Gapping and Right Node Raising according to Schwarz (1999), successfully derives sentences like (14) with the underlying structure (15). I thus adopt the ellipsis analysis to account for the unbalanced disjunction examples. Further, to ensure that *either* occurs with *or*, I claim that *either* is syntactically required to take a DisjP as its argument and *or* inside the DisjP has to take two disjuncts of the same type/size (cf. Law of coordination of likes), thus motivating the ellipsis treatment when the surface form is unbalanced.

However, even though the ellipsis analysis explains very well the unbalanced disjunction data, it has a crucial problem that it does not have much to say about the availability of the WS reading for sentences with *either* in its base position, adjacent to the DisjP. Recall that such sentences are ambiguous, having both NS and WS readings, as we have seen in (4) in Section 2.

(26) a. Mary is looking for a maid or a cook.
b. Mary is looking for either a maid or a cook.
(i) $[\![\text{look for}]\!]([\![\text{a maid or a cook}]\!])$ (m) (NS reading)
(ii) $[\![\text{look for}]\!]([\![\text{a maid}]\!])(m) \vee [\![\text{look for}]\!]([\![\text{a cook}]\!])$ (m) (WS reading)

In such "balanced disjunction" examples, there is no motivation to posit ellipsis in the derivation of the sentences, and thus in the ideal case, ellipsis would not be involved in the derivation of these sentences. Thus the ellipsis analysis predicts that only the NS reading is possible. The ellipsis analysis on its own leaves unexplained the problem of the ambiguity of the sentence when *either* is in its base position.[4]

It is precisely this problem that the choice function analysis readily explains. I next turn to the details of the choice function analysis.

3.2. The choice function analysis of disjunction

In this section, I review the choice function analysis of disjunction suggested in Winter (2001) and Schlenker (2006). It is shown that the analysis can explain the ambiguity that sentences with *either* in its base position and the fact that the WS reading is available in sentences with the disjunction in an island. Winter (2001) suggests a (Skolem) choice function analysis for disjunction and claims that through existential closure over the choice function variable that the disjunction introduces, we obtain the WS reading as in (27).[5] This is basically applying the choice function analysis that he proposes for indefinites to disjunction.

(27) If Bill praises Mary or Sue then John will be happy.
$\exists f[\text{CH}(f) \wedge [\langle\ \rangle^d(min(M \cup S))(\lambda x.\text{praise}'(x)(b') \rightarrow \text{happy}'(j'))]]$
$= \exists f[\text{CH}(f) \wedge [\langle\ \rangle^d(\{\{m'\},\{s'\}\})(\lambda x.\text{praise}'(x)(b') \rightarrow \text{happy}'(j'))]]$
$= \exists A \in \{\{m'\},\{s'\}\}[(\lambda P.A \subseteq P)(\lambda x.\text{praise}'(x)(b') \rightarrow \text{happy}'(j'))]$
$= [\text{praise}'(m')(b') \rightarrow \text{happy}'(j')] \vee [\text{praise}'(s')(b') \rightarrow \text{happy}'(j')]$ (Winter, 2001: 159)

[4]The fact that the ellipsis analysis predicts that *either* marks the exact scope of *or* becomes problematic again when we see data other than the basic ones in Section 4.

[5]M and S are the quantifiers corresponding to the proper names *Mary* and *Sue* respectively (and thus can be connected by Generalized Disjunction as in (27)) and the notations m′ and s′ are the lexical denotations of Mary and Sue respectively. The operator min (for the operation Minimum Sort) takes Q, a set of objects of type τ (which is a boolean type) and gives back the set of minimal sets of Q, where a set A is a minimal set of Q iff A is in Q and every proper subset of A is not in Q.

(i) $\text{min} = \lambda Q_{\tau t}.\lambda A_{\tau}.Q(A) \wedge \forall B \in Q\ [B \subseteq A \rightarrow B = A]$ (Winter, 2001: 53)

$\langle f\rangle^d$ is a distributive version of a choice function. The operator $\langle\ \rangle^d$ lifts a choice function with the following definition.

(ii) $\langle\ \rangle^d = \lambda g_{(ett)(et)}.\lambda A_{ett}.\lambda B_{et}.\ A \neq \emptyset\ \wedge\ g(A) \subseteq B$

Importantly, the choice function analysis has the obvious advantage that, since existential closure is not confined within islands, it successfully predicts the availability of the WS reading in sentences with no *either* or with *either* in its base position ((4), (6), (9)), even if the disjunction is inside an island. Furthermore, since existential closure can be applied to any node whose semantic type is *t*, the choice function analysis can account for the ambiguity that the sentences have; namely having both the NS and WS reading. Thus the choice function analysis neatly explains the ambiguity of sentences with no *either* or with *either* in its base position, which was a problem for the ellipsis analysis alone as we have seen in Section 3.1.

However, the choice function analysis has at least two problems. First, it has difficulty in deriving the WS reading for sentences with floated *either* since the analysis in itself does not have the machinery to derive the reading. In such sentences, the surface form is unbalanced disjunction, while the WS reading involves two propositional disjuncts as we can see from (5) repeated below.

(28) a. Mary is either looking for a maid or a cook.
b. Mary either is looking for a maid or a cook.
c. Either Mary is looking for a maid or a cook.
(i) ?*$[\![\text{look for}]\!]([\![\text{a maid or a cook}]\!])\ (\text{m})$ (NS reading)
(ii) $[\![\text{look for}]\!]([\![\text{a maid}]\!])(\text{m}) \vee [\![\text{look for}]\!]([\![\text{a cook}]\!])\ (\text{m})$ (WS reading)

Second, the choice function analysis of disjunction has a problem in the mechanism used to determine the position of the choice function variable, and it becomes visible when we closely inspect the unbalanced disjunction example (28a). The problem is, the choice function analysis of disjunction actually does not rule out the possibility of the choice function variable being introduced at a position lower than is actually allowed. Since, according to the choice function analysis of disjunction, the only thing that the disjunction does is to require that the two disjuncts be of the same size and to introduce a choice function variable just outside the DisjP, there is no way to determine the size of the DisjP and the position where the choice function variable is introduced just from the role of the disjunction. Thus, for example, the choice function analysis of disjunction wrongly predicts that we can place the choice function variable just above *[a maid or a cook]* in (28a). The requirements of the disjunction are fulfilled in this situation, conjoining two disjuncts of the same size and placing the choice function variable above the DisjP. This results in the narrow scope reading of the disjunction, which the sentence does not have.

Thus a pure choice function analysis also have problems. In Subsection 3.3, I propose that we need to combine the choice function analysis with the ellipsis analysis in order to solve the first problem, and in addition, we need to modify the choice function analysis so that *either*, not *or*, introduces the choice function variable in order to solve the second problem.

3.3. The hybrid analysis

In previous subsections, I have shown that the ellipsis analysis and the choice function analysis of disjunction both have advantages and problems. The ellipsis analysis is able to account for the obligatory WS reading of floated *either* examples, but it cannot explain the availability of the WS reading in sentences with *either* in its base position. The choice function analysis of disjunction can explain the ambiguity of sentences with *either* in its base position, but lacks the machinery to derive the WS reading in floated *either* examples and overgenerates the NS reading.

Now we can see that the problem of the ellipsis analysis and the first problem of the choice function analysis of disjunction are solved if we combine the two analyses. The first version of the hybrid analysis, "the ellipsis analysis + the choice function analysis of disjunction," is given in (29). Below I give an overview of how the analysis can explain the basic data set. In sentences with no *either* or with *either* in its base position (30), where there is an ambiguity between narrow scope and wide scope *or*, no ellipsis is involved in the derivation of "balanced disjunction." Thus there are multiple possible positions for Existential Closure which correspond to the multiple possible scope positions of *or*.

(29) The ellipsis analysis + the choice function analysis of *or*
  a. *Either* syntactically requires a DisjP as its argument
  b. *Or* semantically requires two disjuncts of the same semantic type
  c. *Or* introduces a choice function variable

(30) **Ambiguous between NS and WS *or***
  a. Mary is looking for a maid or a cook.
  b. Mary is looking for <u>*either*</u> a maid or a cook.
  ⇒ **No ellipsis / Multiple possible positions of Existential Closure**
  $[\exists f]$ Mary is looking for $[\exists f]$ PRO to FIND f($\{a\ maid, a\ cook\}$) (cf. Larson et al. (1997))

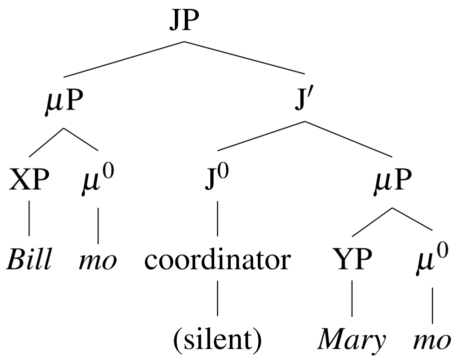
In sentences with floated *either* as in (31), where the WS reading is forced, *either* marks the left edge of the first disjunct and ellipsis is involved in the derivation. Since the choice function variable is introduced with the disjunction, Existential Closure is restricted to a position above the DisjP. Thus we can account for the fact that only the WS reading is available in the sentences.

(31) **Unambiguous: only WS *or***
  a. Mary is <u>*either*</u> looking for a maid or a cook.
  b. Mary <u>*either*</u> is looking for a maid or a cook.
  c. <u>*Either*</u> Mary is looking for a maid or a cook.
  ⇒ **Involve ellipsis / Existential Closure possible only above DisjP**
  a. Mary is <u>*either*</u> looking for a maid or ~~looking for~~ a cook.
  ∃f. Mary is f($\{looking\ for\ a\ maid, looking\ for\ a\ cook\}$)

b. Mary *either* is looking for a maid or ~~is looking for~~ a cook.
$\exists$f. Mary f($\{is\ looking\ for\ a\ maid, is\ looking\ for\ a\ cook\}$)
c. *Either* Mary is looking for a maid or ~~Mary is looking for~~ a cook.
$\exists$f. f($\{Mary\ is\ looking\ for\ a\ maid, Mary\ is\ looking\ for\ a\ cook\}$)

The first version of the hybrid analysis seems to explain well the data set in Section 2. However, the second problem of the choice function analysis of disjunction, namely the analysis predicts that a NS reading is available for the "floated *either*" examples, remains. This problem arises because we have assigned the role of introducing the choice function variable to the disjunction. This is the point where the analysis needs refinement. What, then, has the role of introducing the choice function variable? The obvious alternative candidate is *either*, and this indeed seems to be the right choice to make. Observe that, in all of the examples we have seen in (30) and (31), the position where the choice function variable is placed actually coincides with the overt position of *either*. Thus I propose that the item that has the role of introducing the choice function variable is *either*, rather than *or*, and argue for a choice function analysis of *either*.

As for the semantic role of *or*, I assume that *or* forms a set consisting of the disjuncts (cf. Alonso-Ovalle (2006)) that serves as the argument of the choice function variable. I adopt the claim made by Mitrović and Sauerland (2014) for the syntactic structure and the semantic computation inside coordination. Mitrović and Sauerland (2014) give a decomposed structure (32) for the Japanese phrase involving conjunction *Bill mo Mary mo* ''Bill and Mary.'

(32)


According to Mitrović and Sauerland (2014), languages can be classified into languages with an overt μ head such as Japanese *mo*, which can be used as a quantificational particle or a focus particle, and languages with an overt J(unction) head such as English *and*, which can be used when the coordinated items are individuals and when the coordinated items are propositions. The semantics of the two heads is as in (33).

(33) a. $[\![\mu^0]\!](\mathrm{R}_{<et>})(\mathrm{S}_{<et>}) = \mathrm{R} \subseteq \mathrm{S}$
b. $[\![\mathrm{J}^0]\!](\mathrm{Q}_{1<ett>})(\mathrm{Q}_{2<ett>}) = \mathrm{Q}_1 \cap \mathrm{Q}_2$

With the help of the type-shifting operation from *e* to *et* at the XP/YP level, the individuals Bill and Mary are shifted to their characteristic properties and can combine with μ^0. The overall denotation of JP in (32) is thus the set $\{Bill, Mary\}$. Although the semantic difference between conjunction and disjunction needs to be clarified, I claim that the denotation of a DisjP is the set of the disjuncts and adopt the claim of Mitrović and Sauerland (2014) that the denotation can be derived compositionally.

Other elements of the hybrid analysis, namely (29a) and (29b), are carried over, so the final version of the hybrid analysis is as in (34). I also claim that even in sentences where *either* is covert, the presence of *or* indicates that a phonetically null version of *either* is present in the structure, thus ensuring that the possible readings are the same as for sentences with overt *either*.[6]

(34) The ellipsis analysis + the choice function analysis of *either*
  a. *Either* syntactically requires a DisjP as its argument (= (29a))
  b. *Or* semantically requires two disjuncts of the same semantic type (= (29b))
  c. *Either* introduces a choice function variable
  d. *Or* semantically forms a set of the disjuncts that serves as the argument of the choice function variable

Below I show how interpretations are assigned for sentences with *either* in its base position (36) and with floated *either* (37). By claiming that *either* syntactically selects a DisjP and semantically introduces a choice function variable as in (35), we carry on the advantage of the choice function analysis and at the same time avoid the trouble of wrongly predicting a NS reading for the sentences in (31).

(35) $[\![either]\!]$ = f: f $\in$ D_{cf}
  (where f is a choice function Chf(f) iff for all P in dom(f): f(P) $\subseteq$ P)

(36) Mary$_i$ is looking for [$_{TP}$ PRO$_i$ TO FIND [$_{XP}$ either [$_{DisjP}$ a maid or a cook]]].
  a. $[\![XP]\!] = [\![either]\!][\![DisjP]\!]$
  = f ({a maid, a cook})
  b. $[\![TP]\!] = \lambda w.\exists f$. Chf(f) & Mary to find f({a maid, a cook}) in w
  c. $[\![(36)]\!] = \lambda w'$. Mary is looking for [$\lambda w.\exists f$. Chf(f) & Mary to find f({a maid, a cook}) in w] in w$'$

(37) Mary$_i$ is [$_{XP}$ either [$_{DisjP}$ looking for PRO$_i$ TO FIND a maid or ~~looking for PRO$_i$ TO FIND~~ a cook]].
  a. $[\![XP]\!] = [\![either]\!][\![DisjP]\!]$
  = f ({$\lambda x.\lambda w'$. x is looking for [λw. Mary to find a maid in w] in w$'$, $\lambda x.\lambda w'$. x is looking for [λw. Mary to find a cook in w] in w$'$})

[6] A point that needs explanation if we are to argue for the presence of covert *either*/Op is that in a question, the possible readings differ as to whether there is overt *either* or not. When there is no overt *either*, the sentence is ambiguous between an Alternative Question (AltQ) reading and a Yes/No Question (YNQ) reading as in (ia), while sentences with overt *either* only have the YNQ reading as in (ib) and (ic) (although there seems to be some speaker variation). I leave this problem for future research.

(i) a. Did Mary look for a maid or a cook? (AltQ / YNQ)
  b. Did Mary look for either a maid or a cook? (*AltQ / YNQ)
  c. Did Mary either look for a maid or a cook? (*AltQ / YNQ)

b. $[\![(37)]\!] = \exists$f. Chf(f) & f($\{\lambda x.\lambda w'$. x is looking for [λw. Mary to find a maid in w] in w$'$, $\lambda x.\lambda w'$. x is looking for [λw. Mary to find a cook in w] in w$'\}$)

In this section, I have shown that the hybrid analysis, which combines the choice function analysis of *either* with the ellipsis analysis, fully accounts for the basic data set in Section 2. In the next section, I discuss the predictions that the hybrid analysis makes and some data that are problematic at first sight.

4. Conclusion and further issues

In this paper I have investigated the availability of the WS reading in the *either* ... *or* ... construction and its interaction with the behavior of *either*. It has been shown that the WS reading should be treated semantically, rather than syntactically. The rest of this section is devoted to discussion of a prediction that the choice function analysis of *either* + the ellipsis analysis makes and of some data beyond the basic data set that we have limited ourselves to up to this point. The data apparently go against the prediction, but it is shown that the data are indeed not problematic, pointing out judgment issues that have been overlooked previously.

A prediction that the present analysis makes is that *either* marks the "minimal possible scope" of *or*. I have claimed that *either* introduces a choice function variable and the scope of the variable is determined by the position of Existential Closure. Existential Closure should thus be able to occur at any type *t* position above *either*.

First consider (6)-(8), repeated in (38)-(40) below.

(38) If Bill praises Mary or Sue then John will be happy. (Winter, 2000: 403)
  a. If Bill praises Mary then John will be happy and if Bill praises Sue then John will be happy. (NS)
  b. If Bill praises Mary then John will be happy or if Bill praises Sue then John will be happy. (WS)

(39) a. If Bill praises either Mary or Sue then John will be happy. (^{OK} NS / ^{OK}WS)
  b. If Bill either praises Mary or Sue then John will be happy. (^{OK} NS / ^{OK}WS)

(40) *Either if Bill praises Mary or Sue then John will be happy. (Winter, 2000: 403)

As shown in (38) and (39), when a DisjP is inside an if-clause, which is an island, both the NS and WS readings are available, and the possible readings are the same in sentences with *either* inside the if-clause. As I have stated above, this is straightforwardly accounted for by the proposed analysis, since Existential Closure is not restricted within islands, and ellipsis that takes place inside the if-clause does not cause any problem. In contrast, (40) at first sight seems to go against the prediction that the choice function analysis makes. This is because, according to the analysis, there is no reason for the sentence to become unacceptable.

It may be possible to posit a restriction on ellipsis to avoid this difficulty, for example claiming that ellipsis is island-sensitive, but I would like to point out that there might be a problem in the data itself. Specifically, some native speakers that I have consulted (although the number is still small) suggested that (40) might be degraded for a syntactic reason rather than a semantic one. In particular, they felt that *either* coming next to *if* itself is bad, which indicates that the cause of the degradedness lies in this particular island. Indeed, at least one native speaker who reports that (40) has a syntactic problem judged (41) as grammatical, in which *either* is overtly outside other islands, such as a complex NP island (41a) and a *wh*-island (41b). Although the judgment has to be confirmed by a larger number of native speakers, this suggests that the overt position of *either* is not constrained by syntactic islands, and if this is the case, the data in (40) is not a problem for the present analysis.

(41) a. John maintains <u>*either*</u> the claim that Bill should resign or retire.
b. John knows <u>*either*</u> who should resign or retire.

However, the problem of the degraded status of (40) remains. Why is it unacceptable even though the full version of the sentence (42) is acceptable?

(42) Either if Bill praises Mary or if Bill praises Sue then John will be happy.

I have no concrete answer to this question, but I would like to suggest that the unacceptability does not come from island sensitivity but from a syntactic restriction on ellipsis inside questions. This is because there seems to be a connection between (40)&(42), disjoined *wh* questions (43) and disjoined Yes/No Questions (44). In all examples the elided versions are bad. Given that there are studies which claim that some conditionals are a kind of question (e.g. Starr (2014)), it might be the case that what makes (40), (43b), and (44b) unacceptable is the same restriction on ellipsis operative inside questions.

(43) a. I need an answer to one of the two questions: Who came or who left?
b. *I need an answer to one of the two questions: Who came or left?

(44) a. I need an answer to one of the two questions: Did John come or did he leave?
b. *I need an answer to one of the two questions: Did John come or leave?

Another point that apparently goes against the prediction of the present analysis that *either* marks the "minimal possible scope" of *or* is Larson's (1985) generalization that we have seen earlier in this paper in (45b).

(45) Larson's (1985) generalization (Winter, 2000: 395):
a. In *or* coordinations without *either*, as well as in *either* ... *or* ... coordinations with *either* undisplaced, the scope of *or* is confined to those positions where *either* can potentially appear.
b. When *either* is displaced it specifies the scope of *or* to be at that displaced position.

Observe that the generalization in (45) states an imbalance in the semantic role of *either*: on the one hand, in sentences with no *either* or with *either* in its base position, *either* marks the minimal possible scope of *or* (45a), but on the other hand, in sentences with floated *either*, *either* marks the exact scope of *or* (45b). This imbalance between the positions of *either* would be a difficult problem to explain. However, some native speakers I have consulted do not agree with the "exact scope marking" nature of floated *either* but judge that floated *either* also marks the minimal possible scope of *or*.

Let us see the examples from Larson (1985). The sentences in (46) have embedded non-finite clauses. In sentences with no *either* (46a) or with *either* in its base position (46b), there are three possible readings: (A) *or* taking narrowest scope, below *look for*, (B) *or* taking scope at the embedded clause level, and (C) *or* taking widest scope at the main clause level. Larson's (1985) judgment for (46c) and (46d) is that the position of floated *either* coincides with the scope of *or*, as given in the second line of the table. The judgment of some native speakers I have consulted, given in the third line of the table, differs crucially from Larson's (1985) in the judgment of (46c). Specifically, they judge that both the (B) reading (the exact scope reading) and the widest scope reading of *or* are available. This shows that they judge that floated *either* marks not the exact scope of *or* but the minimal possible scope of *or*. Thus their judgment does not accord with (45).

(46) Non-finite clauses (Larson, 1985: 221)
 a. Sherlock pretended [to be looking for a burglar or a thief].
 b. Sherlock pretended [to be looking for <u>either</u> a burglar or a thief].
  A. S. pretend to look for ((a burglar) or (a thief))
  B. S. pretend [S. look for (a burglar) or S. look for (a thief)]
  C. S. pretend to look for (a burglar) or S. pretend to look for (a thief).
 c. Sherlock pretended [to <u>either</u> be looking for a burglar or a thief].
 d. Sherlock <u>either</u> pretended [to be looking for a burglar or a thief].

	(44a,b)	(44c)	(44d)
Larson (1985)	^{OK}A, ^{OK}B, ^{OK}C	*A, ^{OK}B, *C	*A, *B, ^{OK}C
Other native speakers	^{OK}A, ^{OK}B, ^{OK}C	*A, ^{OK}B, ^{OK}C	*A, *B, ^{OK}C

If this intuition turns out to be correct, it makes it easier to account for the scope of *or* and its interaction with *either*, since we do not have to say, for example, that base-generated *either* has to move covertly to mark the scope of *or* while floated *either* overtly marks the scope of *or*, which Larson (1985) actually proposes. What is more, the uniform "minimal possible scope marking" nature of *either*, if it is real, fits very well with the choice function analysis argued for in this paper, confirming the prediction that the analysis makes, namely that *either* should mark the minimal possible scope of *or*. Thus there might be supporting evidence to further extend the analysis to data outside the basic data set. Note that the ellipsis analysis on its own predicts that *either* would mark the exact scope of *or*, lending further support not to adopt a pure ellipsis analysis but to combine it with the choice function analysis of *either*.

Before closing the section, let me briefly state another prediction of the present analysis related to the one discussed in this section: *either* marks the minimal scope of *or*, and what is more, the scope of *or* must be unbounded. This is because, as far as I understand, there is no way to keep Existential Closure from taking place when the semantic type of the node is type t. The prediction that the scope of *or* must be unbounded is a falsifiable one, and I leave further investigation into this question for future research.

This section has discussed the predictions that the hybrid analysis makes, pointing out judgment issues that have been overlooked previously and opening up the possibility that the hybrid analysis can cover data outside the basic ones.

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Hillary Clinton is not Mitt Romney rich: Nouns modifying degree and dimension of adjectives[1]

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Abstract. In loose English speech, speakers can be observed to use nouns to modify adjectives. This paper explores the four readings which this construction can attain, associated with four types of parameters typically associated with adjectives: degrees, judges, comparison classes, and dimensions. A formal analysis is put forth that derives all four phenomena by recentering pragmatic halos around the modifying noun.

Keywords: adjectives, degree, dimensions, comparison class, equative, alternatives.

1. Introduction

Consider the sentence in (1).

(1) Hillary Clinton is rich, but not Mitt Romney rich.

Mitt Romney rich is indicative of a construction that seems unique to varieties of English, where a noun phrase modifies the meaning of the following adjective. *Mitt Romney rich* can be ambiguous between several different readings.

(2) a. How rich is Hillary Clinton?
b. Does Hillary Clinton care about poor people?
c. Mitt Romney's only inviting rich people to his birthday party, did he invite Hillary Clinton?

As an answer to the first question, (1) obtains the DEGREE READING: *Mitt Romney rich* means something similar to *as rich as Mitt Romney*. The second question obtains a DIMENSION READING, *Mitt Romney rich* means something like *rich in the way Mitt Romney is*. The third reading is a JUDGE READING, similar to *is considered rich by Mitt Romney*. A fourth reading is more difficult to obtain with the sentence in (1), but is more apparent in (3).

(3) They are rich, of course [...], but not *New York City* rich.

Here we obtain a COMPARISON CLASS READING, *New York City rich* means something like, *rich for someone in NYC*.

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These four readings correspond to four aspects of adjectives that can be context dependent; the scale of the adjective (see Solt, 2016; Sassoon, 2010; Kennedy, 2013), the judge argument (Lasersohn, 2005; Stephenson, 2007; Kennedy, 2013; Bylinina, 2014), the standard degree, and the comparison class on which that standard is set. In section 2, I will discuss the data in question, exploring properties of each reading. In section 3, I will propose an analysis using pragmatic halos to account for all the types with a uniform semantics. Finally, in section 4 I conclude.

2. Basic data

Here, I call these constructions *reference modifiers* (RMs), in two senses. Bolinger (1967) previously used *referent* vs. *reference modification* to distinguish between attributive adjectives that modify what the noun refers to (*huge* in (4a)), and those that modify the noun itself (*Asian* in (4b))—this distinction is basically the distinction between intersective and nonintersective interpretations of adjectives (Partee, 1995).

(4) a. Those are huge elephants. ([[huge elephant]]$=$**huge**$\cap$**elephant**)
b. Those are Asian elephants. ([[Asian elephant]]$\neq$**Asian**$\cap$**elephant**)

Whether all RMs of the form referred to in this in paper modify reference rather than referent is a question that cannot be answered without a theory of the semantics of the modifier itself, but we can note that some readings (particularly dimension readings) can be interpreted in clearly non-intersective ways. *Osama Bin Laden famous* can refer to a scale of how derived from or related to acts of terror one's fame is, a scale that cannot be a referent of an unmodified *famous*. In the sentence (5), the studios are still able to hire individuals that are more famous than the actor, but not those who are more *Osama Bin Laden famous*.

(5) After the scandal, the actor was too *Osama Bin Laden famous* to hire. $\not\to$ too famous to hire.

More simply, I call these RMs because the majority of these constructions modify by referencing an individual or a prototype that must be known to the interlocutors; often a figure or event from pop culture. Now we turn to some of the basic facts of RMs.

2.1. Modifier-adjective positive requirement

Only certain readings of RMs require that what the modifier is referring to be in the positive extension of the adjective. Roughly, if in some context a RM *Modifier Adjective* (*Modifier*=Mitt Romney, *Adjective*=rich) is grammatical, *Modifier is Adjective* must be true in that context. This is unsuprisingly untrue for the JUDGE READING (6), as expected, because judge RMs denote the positive extension of an adjective as judged by the referent of the modifier; the example in (6) gets the judge reading particularly well because this is the only reading where the referent of the modifier can be incompatible with the scale discussed.[2]

(6) The salsa isn't spicy, but it is *my dad spicy.*

The Comparison Class reading does require compatibility with the adjective, but is fully grammatical even if the prototypical member of the comparison class referred to by the modifier does not satisfy the adjective in its positive form. Consider (7): one would be hard pressed to find a context where mansions were cheap, but we are able to get a comparison class reading where the house in question is cheap for a mansion. This reading, like *for*-phrases (Kennedy, 2007; Bale, 2008; Solt, 2011), does require that the subject is a member of the comparison class.

(7) It isn't cheap, but it is *mansion cheap* and if you want a mansion that's as good as you're gonna get.

The degree reading does require that the positive sentence to be true to be grammatical, consider (8). This sentence does not work unless we are in some context where snails are considered fast.

(8) #The animal was *snail fast*.

Further, I argue that the dimension reading requires this as well.[3] The sentence in (9) can obtain a meaning where the person in question is shorter than the speaker's threshold for *tall* but is a politically imposing figure, much like Napoleon (perhaps *tall in spirit*). While we may not consider Napoleon *tall*, in order to get this sort of reading, it is crucial that under some wordplay and metaphorical meaning Napoleon is "politically tall". For a non-tall individual with less culturally relevant jokes made comparing their physical height and their success or imposingness, this does not seem to work. Though James Madison is considered the father of the American Constitution, I have much more difficulty creating *James Madison tall*, as he was a short man.

(9) They're not tall but they're *Napoleon tall.*

The different sorts of relationships required between the modifiers and the adjectives are summed up in the table in (10).

(10) Required relationship between referent of modifier and scale of adjective

Reading	Judge	CC	Degree	Dimension
Compatible	✗	✓	✓	✓
Positive	✗	✗	✓	✓

[2]Of course, a context could exist where we have considered the flavor of our family members, in which case other readings of this sentence would be possible.

[3]However, it seems as if a subtype of dimension readings do not require it. In order to understand *tall in the way Napoleon is tall*, Napoleon must be tall in some way, but *I'm sick, but I'm blood pressure healthy* clearly does not require *blood-pressure* to be *healthy* but is grabbing a dimension directly.

2.2. Degree RMs

The degree reading of an RM (11a) can often be paraphrased as an equative (11b).

(11) a. Mary is *Usain Bolt fast*.
 b. Mary is as fast as Usain Bolt.

However, these constructions differ in two important ways: a degree RM is more imprecise than an *exactly* reading of the equative; and the degree RM can create indirect comparisons using implicit comparison classes.

2.2.1. Implicit comparison classes

Unlike the equative, the degree RM can make indirect comparisons—comparing positions of the individuals on their relative scales—without any overt reference to comparison classes. While the typical equative (and comparative by parallel) construction involve comparison of individuals based upon their degrees on the same scale, sentences like (12) seem to compare individuals based on their degrees on distinct (but often related scales).

(12) a. Marie Curie is smarter than Marilyn Monroe is beautiful. (Modified from Bale, 2011)
 b. John is taller for a man than Mary is for a woman. (Bale, 2011)
 c. Mary is as fast for a middle schooler as Usain Bolt is for an Olympian.

Several recent proposals attempt to explain these indirect equatives (Bale, 2006, 2008, 2011; Sassoon and van Rooij, 2016). Bale (2008) shows that these do differ from metalinguistic comparisons (13) (Embick, 2007; Morzycki, 2011) due to several distributional realities, notably, metalinguistic comparatives have a strong preference (if not a requirement) for the *more* morpheme over the *-er* morpheme.

(13) Seymour is more intelligent than devious. (Bale, 2011)

Degree RMs, like (11b) are able to be true in the case that the indirect comparison seen in (12c) is true, which is not true for the equative without explicit comparison classes, (11b). While the equative can express such a meaning in an exaggerative context, in O'Hara (to appear) I argue that the Degree RM is not achieving these kinds of readings through exaggeration in the same way, as evidenced by the contrast in (14): the literal meaning of *Usain Bolt fast* is the meaning that was used in the first sentence, so *well not literally* contradicts the prior sentence.

(14) Mary is {as fast as Usain Bolt/#*Usain Bolt fast*}. Well not literally...

In these comparison class indirect equatives, somehow the relative position of an individual within their own comparison class is being compared. Therefore, the realities of how we find an individual's relative position in their comparison class is rather important. Bale (2008) handles this by deriving a scale from a linear order of equivalence classes fromed by a relation like *x is as ADJ as y*. Bale defines a universal scale where the equivalence classes of individuals from a given comparison class are evenly spaced.

Thus, if our comparison class for Mary involves six middle school runners, of whom Mary is the fastest, and no two runners are of equal speed; Mary is associated to the maximal possible universal scale degree ($d_{\frac{6}{6}}$), the next runner is associated with $d_{\frac{5}{6}}$ and so on, with the slowest runner being associated with degree $d_{\frac{1}{6}}$. Since Usain Bolt is the fastest man in the world, regardless of the size of the comparison class he is being considered in, Usain is going to be associated to the maximal degree, $d_{\frac{n}{n}}$. Therefore, Mary and Usain Bolt have the same degree on the universal scale, d_1.

However, this approach fails to capture a few intuitions present in indirect comparisons, as noted by Wellwood (2014). Consider Katie Ledecky, American Olympian who finished the 800m freestyle at the 2016 Olympics over a pool length ahead of her opponents. If Mary won her middle school race, but not so significantly, (15) is not as true.

(15) **F** Mary is as fast for a middle schooler as Katie Ledecky is for an Olympian.

Therefore, it seems not only the linear order of the equivalence classes must be preserved when comparing disparate scales, but also the distance between degrees. Sassoon and van Rooij (2016) handle this by formulating the scale *fast for a middle schooler* as the ratio from an individual's speed's deviation from the norm for middle schoolers, and the standard deviation for a middle schooler, (16).[4]

(16) $[[\text{fast for a middle schooler}]] = \lambda x : [[\text{mdschl}]](x). \frac{(\mu_{\text{fast}}(x) - \text{norm}(\mu_{\text{fast}}, [[\text{mdschl}]]))}{\text{std}(\mu_{\text{fast}}, [[\text{mdschl}]])}$

This formulation allows a finer comparison of diverse scales, allowing us to get the correct truth conditions for (15). Under such an interpretation, since Katie Ledecky surpasses the norm for her comparison class by a number of standard deviations, but in our context Mary surpassed the norm by less standard deviations for her comparison class. However, an additional issue could arise: Say Katie Ledecky surpassed the norm of her comparison class by exactly 5 standard deviations, and each standard deviation is relatively large, resulting in a change of race time by about a second. It is possible that Mary could also surpass the norm of her class by 5 standard deviations, but the standard of deviation for her class could be orders of magnitude smaller than Katie Ledecky's. In this case, we note that Katie Ledecky notably finishes before everyone else, but Mary finishes her race in a photo finish with all of the other members of her race, though Katie Ledecky would have the same degree of *fast for an Olympian* as Mary has for *fast for a middle schooler*. This seems potentially problematic, but it seems possible that the difference between these two situations is whether or not the deviation from the norm is observable to the speakers. Standard deviation (a purely mathematical/statistical measure) might not be sufficient.

[4]Solt (2011) uses median absolute deviation in a similar way while trying to define the positive construction.

Unlike the equative, the degree RM does not require an overt comparison class (through a *for*-phrase) to get these indirect, relative readings. I argue the difference here derives from the different ways the degree of the standard (i.e. that which the subject is being compared to, recently Katie Ledecky) is derived. The denotation of the equative involves the calculation of the maximal degree on some scale denoted by the adjective (potentially relativized by comparison classes) which the standard surpasses (17). In (17), $S_{\text{FAST},C}$ represents some relevant scale related to *fast* for some comparison class C.

(17) [[as fast as Katie Ledecky]]$=\lambda x.max(\lambda d.S_{\text{FAST},C}(d,x)) =^{5} max(\lambda d'.S_{\text{FAST},C'}(d',KL))$

However, since by the very nature of an equative (or a comparative) we are comparing the individuals in question, there is a great preference to use a comparison class that includes both individuals; making an indirect comparison unlikely without overt morphology.

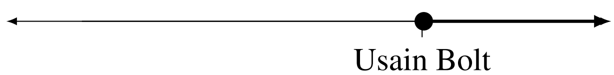
Degree RMs do not have clauses so rather than deriving the degree in the way an equative does, the RM simply selects some degree that is somehow associated to the standard and the adjective. The most salient degrees for a given individual will likely be in their most common comparison class; for Katie Ledecky, it is with the swimmers she raced against at the Olympics, so Mary as a middle schooler will not be part of the comparison class, and will therefore select a different comparison class that is contextually appropriate for her.

2.2.2. Imprecision

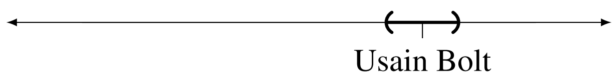
The equative is said to have two readings, the strong *exactly-as* reading, and the weak *at least as* reading. The degree RM seems to quantifiy over a different set of degrees than either of these readings.

(18) a. STRONG EQUATIVE *(exactly) as fast as Usain Bolt*

b. WEAK EQUATIVE *(at least) as fast as Usain Bolt*



c. DEGREE RM *Usain Bolt fast*



The lower bound is apparent in sentences like (19); there must be some degrees of speeds slower than Usain Bolt's speed that still qualify as *Usain Bolt fast*.

(19) a. How fast is Andre de Grasse?

[5] Here I denote an *exactly* reading of an equative, following Rett (2008) that this is basic; this relation would be $\geq$ if an *at least as* reading is taken as basic (Schwarzschild, 2008). Neither are crucial for this point.

b. Andre de Grasse is *Usain Bolt fast*, but he's not as fast as Usain Bolt.

Here, speakers may paraphrase *Usain Bolt fast* as being in the same speed tier as Usain Bolt, allowing for Andre de Grasse to have a lower speed than Usain Bolt, but still be *Usain Bolt fast*. This is actually a fact of the semantic relationship of *Usain Bolt fast* to *as fast as Usain Bolt*, rather than a pragmatic force trying to derive meaning from the sentence. If there was not a difference in in semantics between the two phrases, (20) should be able to capture the same meaning, which it cannot.

(20) #Andre de Grasse is as fast as Usain Bolt, but he's not *Usain Bolt fast*.

Further, we can see that there is in fact an upper bound on RMs unlike the *at least as* reading of the equative. Yao Ming, the former NBA player, is 7'6" tall. Given the same context, there are certain heights, such that someone is not *Yao Ming tall* but they are *as tall as Yao Ming*.

(21) a. Speaker A: My friend Cody is super tall!
b. Speaker B: Are they as tall as Yao Ming?
c. Speaker A: Yes, in fact they're 15 ft tall!

(22) a. Speaker A: My friend Cody is super tall!
b. Speaker B: Are they *Yao Ming tall*?
c. Speaker A: ??Yes, in fact they're 15 ft tall!

This arises from the same sense speakers have that the RM, *Yao Ming tall* refers to a tier of heights around Yao Ming's height. The RM gets a reading closer to *about as tall as Yao Ming* or *around Yao Ming's height*. The fact that this paraphrases to *about* suggests that the RM has a less precise reading than the equative when being evaluated upon the same scale. This is not a surprising result; the RM is a more marked construction than the equative (it is typologicially rare, and rare within (particularly formal) English; the ambiguity of the many possible readings also makes the processing of RMs difficult), and marked constructions tend to have marked meanings, which in this case is the weaker, less precise meaning (Horn, 1984).

2.2.3. Distribution of Degree RMs

A final noteworthy property of Degree RMs is their distribution with overt degree morphology. Like the equative, this construction is unable to appear below other degree quantifiers (23)

(23) a. #Mary is very/too/sorta Usain Bolt fast.
b. #Mary is more/as Usain Bolt fast than/as Jill.

On the other hand, degree RMs are available above gradable degree phrases, like *more* and *too* phrases.

(24) a. Man be glad you're not Yao Ming—You're too tall for this room, but you're not (Yao Ming/way) too tall for this room.

b. You're taller than Kevin, but you're not Yao Ming taller than Kevin, so the picture doesn't look too funny.

These distributional facts show that Degree RMs have the same distribution as degree quantifiers like the comparative, providing evidence that this construction is also a degree quantifier.

2.2.4. Summary of Degree RMs

This section has shown evidence that degree RMs are able to quantify over degrees in a way that is somewhat different than the equative, or any other degree quantifier. Crucially, Degree RMs are able to capture indirect comparisons without any overt comparison class phrase. When Degree RMs do represent direct comparisons, they tend to be interpreted less precisely.

2.3. Judge RMs

While the degree of gradable adjectives is the most studied argument, it is not the only one available to adjectives. The degree which certain items receive on many adjectival predicates is dependent upon the *judge* or the individual doing the evaluation. Predicates of Personal Taste (Lasersohn, 2005) like *fun* are the most clear case—it's more surprising if two people ranked all the rides at an amusement park in order of funness exactly the same than if they disagree somewhere. This can be observed via faultless disagreement (Kölbel, 2003). In (25), the speakers do not contradict each other, because they are differing on the contextually determined judge of funness, rather than anything greater.

(25) a. The roller coaster is more fun than the merry-go-round.
b. No, the merry-go-round is more fun than the roller coaster.

This does not remain true, if the judge is overt, marked by either a *for* or a *to* phrase.

(26) a. The roller coaster is more fun for/to me than the merry-go-round.
b. #No, the merry-go-round is more fun for/to you than the roller coaster.

Thus, predicates of personal taste require a judge in order to be evaluated—whether this judge is supplied by a judge index of evaluation (Lasersohn, 2005) or as a thematic argument (Stojanovic, 2007; Bylinina, 2014), is not important for our purposes. This judge can be targeted by a Judge RM.

(27) The roller coaster is more *me fun* than the merry-go-round.

Subjectivity is not limited to predicates of personal taste; adjectives not associated with objective physical scales, called evaluative by Bierwisch (1989), can be equally subjective. These adjectives include *smart, healthy, lazy*.

(28) *Given Paulo is recovering a full body cast post-accident; and Daniel smokes 20 cigarettes a day and mostly eats fast food.*
 a. Paulo is healthier than Daniel.
 b. No, Daniel is healthier than Paulo.

Sassoon (2013); Bylinina (2014) argue that the source for this subjectivity can come from the multidimensionality of *healthy*; *healthy* quantifies over a variety of scales (blood pressure, mobility, amount of aortic plaque, etc.), and which scales receive which priority/weight is dependent on the context and the speaker.

Unlike predicates of personal taste, *for* and *to* phrases cannot overtly supply a judge argument here, without prosodic breaks setting off the phrase.[6] However, verbs like *find* can supply the judge here.

(29) a. I find Paulo healthier than Daniel.
 b. Paulo is healthier, to me, than Daniel.

A Judge RM is able to capture these subjective versions of these evaluative adjectives as well.

(30) a. I don't care what the doctor says, Paulo is more *me healthy* than Daniel.

Finally, even simple objective unidimensional adjectives like *tall* or *rich* appear to be judge-dependent in the positive.

(31) a. Hillary Clinton is rich.
 b. No, Hillary Clinton is not.

This seems to simply be an issue of where the standard degree supplied by the null POS morpheme, lies relative to Hillary Clinton's degree of wealth. Since this is based on the contextual standard degree, this sort of judge dependence is available in the positive, *very* constructions, and *sorta* constructions, but not in more objective constructions, like the comparative. Again, speakers differ on whether overt *to*-phrases can supply the judge here, but verbs like *find* definitely can.

(32) a. I find Hillary Clinton rich.
 b. Hillary Clinton is rich to me.

The Judge RMs are again able to supply the judge for these sort of constructions, given appropriate context.

(33) *Given Mitt Romney is inviting only people he considers rich to a party.*
 a. Hillary Clinton did not get an invite. She's rich, but not *Mitt Romney rich*.

[6]Speakers may differ in acceptability of these phrases in these contexts; Bylinina (2014) seems to suggest that these comma intonation *for*-phrases are only possible sentence initially; however, several consultants and myself allow them in a variety of positions; and even sometimes without such a clear intonation contrast from with predicates of personal taste.

Exactly how the judge-dependence for each of these types of constructions may differ (see Bylinina, 2014), but the Judge RMs seem to be able to capture these readings regardless.

2.4. Comparison Class RMs

Particularly in the positive construction, comparison classes are also a critical part of evaluating adjectives. Identifying the standard necessarily involves identifying the set which the individual is being compared to.

(34) The rock climbing wall in Maggie Daley Park is tall.

Whether the rock climbing wall in Maggie Daley Park in Chicago is considered tall, depends on what it is being compared to. At 40 ft tall, it is one of the tallest things in Maggie Daley Park, it is taller than the average rock climbing wall, but it is also not very tall in comparison to things in downtown Chicago. Depending on which class we use—things in MDP, rock climbing walls, or things in downtown Chicago—the height at which things are considered tall is different, perhaps 20ft, 35ft, and 600ft. This comparison class can be made explicit using a *for*-phrase.

(35) The rock climbing wall in MDP is tall for {a thing in the park/a rock climbing wall/a thing in Chicago}

These comparison classes can also be overtly noted using a Comparison Class RM.

(36) The rock climbing wall isn't *thing in Chicago tall*, but it is *rock climbing wall tall*.

As discussed in Section 2.2.1, comparison classes are available in degree constructions other than the positive as well. In indirect comparatives, overt comparison classes can be used to compare relative difference from the norm for each class as in (37). Comparison Class RMs may also be available, though they feel degraded (and might be metalinguistic) here (38).

(37) Usain Bolt is faster for an Olympian than Mary is for a child.

(38) (?)Usain Bolt is more *Olympian fast* than Mary is *child fast*.

2.5. Dimension RMs

Where the other three types of RMs interact with adjectives in ways that resemble relatively well-studied concepts, the degree, judge, and comparison class; the dimension RMs interact with a less well-understood aspect of adjectives: the scale upon which they are evaluated. Morzycki (2012) argues that there many adjectives encode several different dimensions in their lexical encoding. In (39), *big* seems to be being evaluated over distinct senses.

(39) a. The US is bigger than Canada (Population)

b. Canada is bigger than the US (Area)

(40) **dimensions**(**big**) = {**size-by-population**, **size-by-area**, **size-by-importance**, ...}

Somehow, the dimensions the adjective is evaluated upon must be selected by context, Morzycki suggests that degree quantifiers like POS existentially quantify over these dimensions: something is big in the case that some dimension of big exists so that the thing surpasses the standard on that dimension.[7] This set of dimensions clearly must be able to be contextually restricted: when speaking about land, the population dimension is not selectable.

As discussed in the section on Judge RMs, Sassoon (2007, 2013) discusses a variety of adjectives that seem to quantify over the dimensions in a different way than *big*. In order to be *healthy*, one must be healthy on all relevant dimensions; i.e. blood pressure, mobility, etc.

Thus many adjectives have multiple dimensions available to them. Specific dimensions can be picked out overtly using a *with regard to* phrase.

(41) a. Japan is bigger with regard to population than Canada.
b. Tara is healthier with regard to blood pressure than I.

RMs are capable of accomplishing the same thing.

(42) a. Japan is more population big than Canada.
b. Tara is more blood pressure healthy than I.

Both of the above constructions are able to shift the dimension of an adjective by referencing the dimension in question directly; but the dimension can also be restricted in a different way by *like* or *in the way* phrases, or Dimension RMs.

(43) a. Nigeria is big like Japan, not big like Canada.
b. Nigeria is big in the way Japan is, not the way Canada is.
c. Nigeria is *Japan big*, not *Canada big*.

Given appropriate context, *big like Japan* means the same thing as *big with regard to population*. However, these constructions seem to be capable of picking out any dimension of the adjective which the modifying individual has a salient (usually large) degree on.

In fact, it is possible in this way to refer to dimensions that are not necessarily quantified over by the adjective typically. For an example, consider that Yao Ming and Andre the Giant were both

[7] Some difficulties might arise for such an account. I have checked with several other speakers, who seem to share the intuition that while (39a) seems to work, (i) is less licit out of the blue, contra to what would be expected if *big* here was simply selecting the **size-by-population** dimension.

(i) ?Japan is bigger than Canada.

This suggests somehow the area dimension has some sort of primacy, only allowing the population dimension out of the blue if the area dimension is ambiguous or at least close.

exceptionally tall men, but Yao Ming is skinner and Andre the Giant is broader. If presented with a giraffe and an elephant of the same height, speakers have little difficulty identifying who is *Yao Ming tall* and who is *Andre the Giant tall.* (or *tall like Yao Ming*, or *tall in the way Yao Ming is*)

(44) a. The giraffe is *Yao Ming tall.*
b. The elephant is *Andre the Giant tall.*

Tall is typically thought of as a prototypically monodimensional measurable adjective. The scale over which it is evaluated is typically the same in all contexts: height. In this context, *Yao Ming tall* paraphrases to something like *tall in a slender way*. We can see that this slenderness dimension is not quantifiable over by *tall*; we are unable to access it using a *with regard to* phrase (45).

(45) # The giraffe is tall with regard to slenderness.

Yet, there are strong restrictions to which sorts of dimensions can be selected here. The dimension must be properties of the Yao Ming's tallness, not simply properties of Yao Ming. Yao Ming is rich and successful, and even given an equally tall but poorer person: Lonnie, *Yao Ming tall* cannot mean tall and rich, and *Lonnie tall* cannot mean tall and poor.

The distinction here comes from other evidence about what dimensions are part of the lexical encoding of *tall*. While plain *tall* does not allow paraphrases of *tall in a slender way* in the same way *healthy* can be paraphrased as *healthy with regards to blood pressure*, evidence that *tall* encodes some information about slenderness, rather than wealth is available from prototypical uses of *tall*.

First consider two cups of the same height, one slender and one as wide as it is tall. If *the tall cup* is referred to, speakers identify the slender cup as *the tall cup*. While slenderness is not typically part of the scale quantified over when identifying *tall*, it can be made accessible here. Wealth is not available in this way; given two people of the same height, one clearly rich, and one clearly poor, speakers will be left confused by reference to *the tall person*.

The second evidence comes from slack regulators and other constructions which strengthen utterances, or make them more prototypical. One of these (which we will return to later, as it seems somewhat related to RMs), referred to as lexical cloning, contrastive focus reduplication, or identical constituent compounding, where a word or phrase is copied in order often achieving a more prototypical meaning (Ghomeshi et al., 2004). Given a building that is 300 ft tall, but 2000 ft long and wide, we can imagine the sentence in (46a). The same sort of result can be seen with typical intensifying slack regulators like *exactly, precisely* and *really*.

(46) a. I guess that building is tall, but it's not *TALL* tall.
b. That building is not *really*/exactly/precisely tall.

The prototypical tall thing's (or perhaps building here) height exceeds its other dimensions, allowing for a slenderness dimension to be accessed here. Thus it seems, somewhere in the lexical encoding these additional dimensions are available. It seems notable here that though prototypically tall things are slender, the polarity of this slenderness dimension is not fixed in the ways the dimensions of *big* and *healthy* are. *Tall in a slender way* and *tall in a broad way* are both valid, but *big in a populous way* and *healthy in a physically fit way* seem less strange than their counterparts *big in a unpopulous way* and *healthy in a physically unfit way*. If these counterparts do exist, they refer to something like *healthy even though very unhealthy in this one dimension*, suggesting individuals must be very healthy on the remaining dimensions to make up for that. It is possible that even *tall in a broad way* is defined this way, as *tall even though not slender*, evidence from this arises from the fact that it is easier to generate *tall in a slender or skinny way* from a reference that is tall in a skinny way than to generate *tall in a broad way* without defining it in opposition to *tall in a slender way*: *telephone pole tall* is easy to understand, in comparison to *Great Wall of China tall*.

These dimension RMs are able to appear below degree morphology, and seem incompatible above degree morphology.

(47) a. The giraffe is more *Yao Ming tall* than the elephant.
b. #The giraffe is *Yao Ming taller* than the elephant.

A worthwhile question is whether or not *Yao Ming tall* is truthfully gradable, or if this is a metalinguistic comparative in (47a). Exactly how to probe this distinction seems difficult: most of the diagnostics that differentiate metalinguistic and true comparatives (Morzycki, 2011) do not occur here. McCawley (1998) notes that only metalinguistic comparatives allow displacement of the comparative morpheme, which does not seem to be possible here.[8]

(48) a. Your problems are legal more than financial.
b. The giraffe is *Yao Ming tall* more than the elephant.

2.6. Data summary

All four types of RMs can appear with a variety of adjectives, more widely than might be expected: Degree RMs can appear with typically gradable predicates like *tall*, but they are also available for adjectives with minimal or maximal standards (Kennedy and McNally, 2005) like *coked-up businessman awake* or *arrow straight*. Judge RMs can appear with predicates of personal taste, but also multidimensional adjectives, and almost all adjectives in a positive construction. Comparison Class RMs are equally able to appear seemingly with any gradable adjective. Finally, dimension RMs appear with conventionally multidimensional adjectives like

[8] However, it may be that this property of comparing predicates rather than subjects, identifying metalinguistic comparatives that compare individuals seems more difficult, and I'm not certain works here; seeming to get a different frequency sense in (ib).

(i) a. The coffee there is more coldbrew than when I make it.
b. (?)The coffee there is coldbrew more than when I make it.

healthy, ambiguous adjectives like *big* but also a variety of adjectives that have been typically thought of as simple and unidimensional like *tall*.

3. Analysis

In this section, I propose a uniform semantics for RMs that can handle all of these meanings. Each type of RM restricts the meaning of the predicate to a meaning more closely associated with the reference. Here we will see this can be captured by recentering the pragmatic halo (Lasersohn, 1999) denoted by the predicate.

Morzycki (2011); Anderson (2016) capture compositional semantic imprecision using pragmatic halos consisting of alternatives (Hamblin, 1973; Kratzer and Shimoyama, 2002). Under this Hamblinized approach, the denotation of an adjective like tall is as in (49)

(49) $[\![\text{tall}]\!]^{d',C} = \{f_{<d,et>} : f \approx_{d',C} \lambda d \lambda x.\mathbf{tall}(d)(x)\}$

Here, following Morzycki (2011), the $\approx_{d,C}$ relation is a similarity relation, stating that iff $\alpha \approx_{d,C} \beta$, given the similarity scale given in context C, α is similar to β at least to the degree d. Here, the degree of similarity is the contextual degree of precision. Morzycki (2011) and Anderson (2016) make use of this degree (using a typeshift PREC) to capture metalinguistic comparatives (which are argued to be evaluated on the dimension of precision) and precision intensifiers and attenuators. Here rather than manipulating the degree of precision, RMs select one of these alternatives that is best associated with the reference and recenters the halo.

Take *American Football Player healthy*, a dimension RM which seems to select a scale of evaluation of *healthy* that unfortunately prioritizes physical fitness over limiting brain damage. Under Sassoon (2007)'s representation, *healthy* typically denotes universal quantification over the dimensions of health. However, within our pragmatic halo, alternatives that ignore specific dimensions will be available (much like how, as shown by Anderson (2016), *everyone is here* can be uttered by a professor when a few students are missing (p. 23)).

(50) a. $[\![\text{healthy}]\!]^{d',C} = \{f_{<d,et>} : f \approx_{d',C} \lambda d.\lambda x.\forall g \in \mathbf{dimension(healthy)} : [g(d)(x)]\}$

b. $$[\![\text{healthy}]\!]^{.8,C} = \left\{\begin{array}{c} \lambda d.\lambda x.\forall g \in \mathbf{dim(healthy)} : [g(d)(x)], \\ \lambda d.\lambda x.\forall g \in (\mathbf{dim(healthy)} - \mathbf{brain\ health}) : [g(d)(x)], \\ \lambda d.\lambda x.\forall g \in (\mathbf{dim(healthy)} - \mathbf{cholesterol}) : [g(d)(x)], \\ \text{etc.} \end{array}\right\}$$

Given this loose denotation for *healthy*, the RM must simply select the appropriate dimension. This is accomplished using a null operator RM which selects an element of the predicate its modifying that is associated ($\propto$) with the reference.[9]

(51) a. $[\![\text{RM}]\!]^{d',C} = \lambda x_\rho \lambda S_\tau : \exists s \in S[s \propto_{d,C} x].s$

b. $[\![\text{NFL player RM}]\!]^{d',C} = \lambda S_\tau : \exists s \in S[s \propto_{d,C} \mathbf{NFL\ player}].s$

[9]Often this association is the ability of the reference to directly satisfy the predicate, but particularly with judge RMs, this is not possible.

c. $[\![\text{NFL player healthy}]\!]^{d',C} = \{f_{<d,et>} : f \approx_{d',C} \lambda d.\lambda x.\forall g \in (\textbf{dim(healthy)} - \textbf{BrainHealth}) : [g(d)(x)]\}$

One of the reasons selecting a dimension on more unidimensional adjectives like *tall* seems harder is due to the structure of the pragmatic halos for *tall*. Whereas *healthy* at its most precise universally quantifies across all dimensions of healthiness, the additional dimensions of *tall* are less critically related. The alternative selected by *Yao Ming tall*, of tall in a slender way, is only available in very imprecise readings uses of *tall*. Even given the cups having the same height,

(52) The skinny glass is sorta taller than the fatter one.

Anderson (2016) argues that *sorta* expands the pragmatic halo of the predicate it modifies, selecting a degree of precision close to but lower than the standard degree of precision. Thus, the degree of precision must be lower to allow the RM to select any nontrivial dimensions. Earlier we saw that these dimensions are stored in the adjective and are also accessed in the most precise and prototypical readings. I claim that these additional dimensions are available as presuppositions to the most precise meaning of *tall*. If something is not saliently skinny enough, we cannot call it *tall*, but even on high level of precision, wide things are not *less tall* than things which have lower degrees of height than them.

(53) a. #The Pentagon is tall tall.
b. The telephone pole is tall tall.
c. #The telephone pole is more tall tall than the Pentagon

It is not surprising that dimensions referenced in the presupposition of the lexical entry of an adjective are somehow similar to the most precise form of the lexical entry, but it also makes sense that these are less similar than subsets of dimensions like what we explored with *healthy*.

The purpose of the $\propto$ associated relation appears when we attempt to capture comparison class and judge RMs. Consider *fun*, which as a predicate of personal taste contains a judge argument somewhere in its denotation. I will presume a relativist approach here, but noncritically.

(54) a. $[\![\text{fun}]\!]^{d',C,J} = \{f_{<d,et>} : f \approx_{d',C} \lambda d.\lambda x.\textbf{fun}_J(d)(x)\}$

The pragmatic halo here will include functions which are not exactly *fun*—like *exciting*—but will more importantly include *fun* scales that are ordered by different judges. The association function in the RM can note the association of a judge to the function to which they are the judge.

(55) a. $$[\![\text{fun}]\!]^{.8,C,J} = \left\{ \begin{array}{c} \lambda d.\lambda x.\textbf{fun}_J(d)(x), \\ \lambda d.\lambda x.\textbf{exciting}_J(d)(x), \\ \lambda d.\lambda x.\textbf{fun}_{\textbf{me}}(d)(x), \\ \lambda d.\lambda x.\textbf{fun}_{\textbf{you}}(d)(x), \\ \text{etc.} \end{array} \right\}$$

b. $[\![\text{me fun}]\!]^{d',C,J} = \{f_{<d,et>} : f \approx_{d',C} \lambda d.\lambda x.\mathbf{fun_{me}}(d)(x)\}$

Reference to the judge is made again in the positive construction when setting the standard. Assuming a denotation as follows for the POS morpheme, if the RM attaches above the POS morpheme, it can select the correct form.

(56) a. $[\![\text{POS}]\!]^{d',C,J} = \lambda G_{<d,et>}\lambda x.\exists d[G(x)(d) \wedge d! > \mathbf{norm}_J(G)]$

b. $$[\![\text{POS tall}]\!]^{.8,C,J} = \left\{ \begin{array}{c} \lambda x.\exists d[\mathbf{tall}(d)(x) \wedge d! > \mathbf{norm}_J(\mathbf{tall})], \\ \lambda x.\exists d[\mathbf{tall}(d)(x) \wedge d! > \mathbf{norm_{me}}(\mathbf{tall})], \\ \lambda x.\exists d[\mathbf{tall}(d)(x) \wedge d! > \mathbf{norm_{you}}(\mathbf{tall})], \\ \lambda x.\exists d[\mathbf{tall}(d)(x) \wedge d! > \mathbf{norm_{Mitt\ Romney}}(\mathbf{tall})], \\ \text{etc.} \end{array} \right\}$$

c. $[\![\text{Mitt Romney POS tall}]\!]^{d',C,J} =$
$\{g_{<e,t>} : g \approx_{d',C} \lambda x.\exists d[\mathbf{tall}(d)(x) \wedge d! > \mathbf{norm_{Mitt\ Romney}}(\mathbf{tall})]\}$

This predicts that *Mitt Romney rich* is ungradable, and therefore incompatible with degree morphology. This is caused by putting the judge dependence in the positive morpheme: if that assumption is false, judge dependence must be lower and possible with RMs everywhere it is possible with overt *for* and *to* phrases. It is difficult to probe for data that tests this in particular because on these adjectives judge-dependence does not change the ordering of the degrees but only the location of the norm, making *more Mitt Romney rich* and *more rich* coextensive.

Comparison classes work the same way; reference to comparison classes is part of the positive morpheme, (or perhaps somewhere lower in order to capture indirect comparisons, see Sassoon and van Rooij, 2016). Regardless, some alternatives will be something like "has a degree on this scale surpassing the standard for comparison class C on this scale", and the comparison class RM simply selects the alternative with the appropriate comparison class.

Degree RMs are less obvious. Consider the denotation of a gradable predicate, like *fast*. This is made up of a set of alternatives, which are each sets of predicates given different degrees (57b).

(57) a. $$[\![\text{fast}]\!]^{.8,C,J} = \left\{ \begin{array}{c} \lambda d.\lambda x.\mathbf{fast}(d)(x), \\ \text{etc.} \end{array} \right\}$$

b. $$\lambda d.\lambda x.\mathbf{fast}(d)(x) = \left\{ \begin{array}{c} \lambda x.\mathbf{fast}(\mathbf{5mph})(x), \\ \lambda x.\mathbf{fast}(\mathbf{6mph})(x), \\ \text{etc} \end{array} \right\}$$

Here, the RM selects an element from this set rather than the set of alternatives. A degree that is associated with an individual like Usain Bolt may be his most famous speed (27.7 mph), or using a less measured set of degrees, it could be something like a very high degree. This ambiguity between the exact speed and the relative speed is what allows the ambiguity between direct and indirect comparisons discussed previously. The set of alternatives for *Usain Bolt fast* include a variety of degree near but not equal to Usain Bolt's degree of speed.

(58) a. $[\![\text{Usain Bolt fast}]\!]^{d',C,J} = \{f_{<e,t>} : f \approx_{d',C} \lambda x.\mathbf{fast}(\mathbf{27.7mph})(x)\}$

4. Conclusion

Thus, RMs can be formulated as recentering pragmatic halos, capturing all the four readings discussed in this paper. This approach is able to capture these constructions, but also should be extendible to a variety of similar seeming constructions with different categories of predicates. The lexical cloning construction (*salad salad* or *tall tall*, Ghomeshi et al., 2004) would be a subtype of this: the alternative most associated with the predicate itself would be the most precise alternative, and this semantically vacuous recentering of the halo could cause a change in the degree of precision. Other related forms are: Judge RMs on the precision variable (59a), dimension RMs on nouns (59b) or verbs (59c). Further work must be done to investigate the full range of RMs in English.

(59) a. *Given Sam is known to be imprecise*: Is everybody there, or is it just *Sam everybody*?
b. The biggest bird is like an *ostrich bird* not a *eagle bird* so it can't fly.
c. My son can swim, but he can only *baby swim*, so he's not going out on a boat.

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One *many*, many readings[1]

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Abstract. This paper pursues a unified analysis of the different readings that the so-called quantifier *many* gives rise to. Adopting a degree-based semantics account, *many* is decomposed into a gradable cardinality predicate and the positive operator POS. The different readings are argued to result from different scope of POS and association with focus. This improves on alternative accounts, which either employ more than one lexical entry for *many* or do not specify a compositional implementation.

Keywords: quantifier decomposition, degree semantics, positive operator

1. Introduction

It is well known that the quantifier *many* gives rise to several readings. Partee (1989) distinguishes the so-called cardinal and proportional reading of *many*. Under the cardinal reading, a sentence with *many* is true iff the number of individuals that fall in the intersection of the restrictor and the nuclear scope counts as large in the given context. Sentence (1) under the cardinal reading, for instance, is true in a scenario where the number of students who took Intro to Semantics is considered large, e.g. compared to other courses or compared to previous years.

(1) Many students took Intro to Semantics.

Under the proportional reading, sentence (1) can be paraphrased as 'A high proportion of all the students took Intro to Semantics' and comes out as true if the ratio of the number of students taking Intro to Semantics to the total number of students counts as high in the given context. Under the proportional reading, the truth of a sentence does not only depend on the number of individuals in the intersection, but also on the number of individuals in the denotation of the NP. In contrast to the cardinal reading, we also learn something about the students who did not take Intro to Semantics, namely that their number is small.

Besides the cardinal and proportional reading, Westerståhl (1985) noted an additional reading of *many*. This reading is illustrated by his celebrated sentence (2), which is intuitively considered true in the scenario in (3) (describing the actual state of affairs at the time Westerståhl's paper was written), but false both under the cardinal and proportional reading – neither the absolute number 14 can be considered large nor the ratio of 14 to millions of Scandinavians.

(2) Many Scandinavians have won the Nobel Prize in literature.

(3) Of a total of 81 Nobel Prize winners in literature, 14 come from Scandinavia.

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Intuitively, sentence (2) is true in the scenario in (3) because 14 out of a total of 81 Nobel Prize winners in literature is considered a high proportion. In this case the relevant proportion is determined not with respect to the NP denotation, but with respect to the denotation of the VP. Since this reading can be paraphrased as 'Many of the Nobel Prize winners in literature are Scandinavians', with the arguments of *many* reversed in comparison to the sentence (2), this reading has become known as the reverse reading.

One way of coping with this three-way ambiguity would be to employ three different lexical entries for *many*, each corresponding to one of the readings discussed above. In the framework of Generalized Quantifier Theory (GQT), we would then have the following determiners:[2]

(4) a. $[\![\text{many}_{\text{CARD}}]\!] = \lambda P.\lambda Q.\ |P \cap Q| > n$, where n is a large number CARDINAL
b. $[\![\text{many}_{\text{PROP}}]\!] = \lambda P.\lambda Q.\ |P \cap Q| : |P| > k$, where k is a large fraction PROPORTIONAL
c. $[\![\text{many}_{\text{REV}}]\!] = \lambda P.\lambda Q.\ |P \cap Q| : |Q| > k$, where k is a large fraction REVERSE

The lexical entry for $\textit{many}_{\text{REV}}$ in (4c) is particularly noteworthy, as pointed out by Westerståhl (1985). Since it makes reference to the cardinality of the VP denotation, it violates the Conservativity Universal (Barwise and Cooper, 1981; Keenan and Stavi, 1986). According to this semantic universal, determiners in natural languages are conservative, which means that the extension of the second argument of a determiner counts only insofar as it overlaps with the extension of the first argument, corresponding to the restrictor. But for reverse *many* in (4c), the entire extension of the second argument enters into the truth conditions.

Even leaving aside the issue of non-conservativity raised by the lexical entry for reverse *many*, there are obvious reasons to be dissatisfied with the meaning rules in (4). Employing a separate lexical entry for each reading is not very insightful and a more parsimonious way of dealing with the ambiguity that *many* gives rise to would be welcome.

The aim of the present paper is to explore a unified analysis in which the different readings are derived from a single lexical entry of *many.* Recent advancements in semantic theory give reasonable hope to such an endeavor. There is a growing body of work that decomposes the expressions GQT labels as quantifiers into smaller meaningful parts and derives the interpretations these expressions give rise to in a fully compositional way (Hackl, 2000, 2009 among many others). The analysis developed in the present paper builds in particular on Romero (2015, 2016), who shows that the reverse reading can be explained under the assumption that the so-called quantifier *many* is the positive form of a gradable determiner *many,* which is analysed in a degree-based semantic framework in analogy to gradable adjectives. While the present paper follows Romero in adopting a degree semantics account and her analysis of the positive operator, the goal of the investigation is to take the analysis a step further and derive all three readings from a single lexical entry in a compositional manner. The key idea is that *many* itself is a gradable cardinality predicate that combines with the positive operator POS,

[2] Cardinal *many* has also been treated as a cardinality predicate rather than as a genuine quantifier (Hoeksema, 1983; Partee, 1989, among others). Motivation for this comes from the observation that cardinal *many* patterns with indefinites and other so called weak determiners in terms of distribution in existential *there*-sentences and in subject position of individual-level predicates (Milsark, 1977); see section 4.2. We will use a version of this cardinality predicate analysis that makes the parallel between *many* and gradable adjectives transparent.

and the different readings result from different scope of POS (cardinal vs. proportional readings) and (free) association with focus (regular vs. reverse readings).

The paper is organized as follows: Section 2 lays out the ingredients that go into the analysis: on the one hand *many* as gradable cardinality predicate, on the other the semantics of degree operators, in particular of the positive operator. The analysis is presented in Section 3, showing how the different readings can be derived using these ingredients. Section 4 takes a closer look at reverse readings. In Section 5 it is shown how distributional restrictions on the different readings can be explained in terms of the proposed analysis. Section 6 concludes.

2. Ingredients of the analysis

In the analysis I propose, what has been labeled quantifier *many* is analysed as the positive form of a gradable cardinality predicate. There are thus two ingredients that go into the analysis, each having been motivated and proposed independently. The first is the assumption that *many* is not a determiner, but rather a gradable cardinality predicate. The second is the semantics of degree operators, specifically the semantics of the positive operator.

2.1. *Many* as a gradable cardinality predicate

Since *many* shows an obvious analogy to gradable adjectives – it can be put in the comparative form *more* as well as in the superlative *most* – it has also been proposed that it should be analysed in analogy to gradable adjectives (Schwarz, 2006; Hackl, 2009, among many others). In this type of analysis, *many* is a cardinality predicate with the semantics in (5).[3]

(5) $[\![\text{many}]\!] = \lambda d.\lambda x.\ |x| \geq d$

The lexical entry in (5) follows the usual semantics assumed for gradable adjectives (e.g., Heim, 2001) and is formulated in analogy to that of gradable adjectives like *high* in (6). Note in particular that this semantics for gradable adjectives is downward monotonic, in the sense that a specific individual is not only associated with a single degree, but with a set of degrees: *high* is a relation between an individual x and all degrees up to x's exact height, i.e. all degrees contained in the interval $(0, \text{HEIGHT}(x)]$.

(6) $[\![\text{high}]\!] = \lambda d.\lambda x.\ \text{HEIGHT}(x) \geq d$

The dimension that *many* targets is that of cardinality. In a mereological framework of plural semantics (Link, 1983), *many* relates a plural individual with the number of atomic parts it consists of, i.e. $|x|$ is the cardinality of $\{y\text{: atom}(y)\ \&\ y \leq x\}$.[4]

Under this view, *many* is a predicate rather than a determiner. Quantificational force, therefore, has to come from somewhere else. I adopt the common assumption that there is a

[3] I use a semantics in which the cardinality measure function is part of the meaning of *many.* There are, however, reasons to believe that the measure function is separate and not lexically contained in *many* (see Solt, 2009, 2015). For the purpose of the present paper, nothing hinges on this difference.

[4] I will sometimes sloppily talk about the cardinality of a plurality.

phonetically empty determiner ∅ with the semantics of an existential quantifier. I assume that ∅ is present whenever *many* occurs without an overt determiner.[5]

Just as gradable adjectives, *many* can combine with a range of degree operators: when it combines with the comparative operator it surfaces as *more*, and as *most* when it combines with the superlative operator (Bresnan, 1973; Hackl, 2000, 2009). In the cases we are interested in, where *many* occurs without a overt degree modifier, a phonetically empty positive operator POS is assumed. Before we discuss the semantics of POS in detail, let us first look at degree operators more generally.

2.2. Scope of degree operators and association with focus

In order to introduce some key features of degree operators, which will be put to use in the analysis of *many,* let us first look at the semantics of superlatives and the influential analysis in Heim (1999). The analysis starts out from the observation that superlatives are ambiguous between absolute and relative readings (Szabolcsi, 1986). Consider the following sentence.

(7) John climbed the highest mountain.

Under the absolute reading, (7) is true iff John climbed a mountain higher than any other relevant mountain. In a situation where we are talking about mountains in Scotland, for instance, (7) under the absolute reading is tantamount to saying that John climbed Ben Nevis. Under the relative reading, (7) is true iff John climbed a higher mountain than any other relevant person. It could be true even if John climbed a mountain of rather modest height, as long as no other person under consideration climbed a higher mountain. Put differently, whereas the heights of mountains are at stake under the absolute reading, the mountain climbing achievements of people are being considered under the relative reading.

In the relative reading, focus plays an important role in determining truth-conditions. This is illustrated in the following contrast:[6]

(8) a. BILL got the best grade in semantics.
b. Bill got the best grade in SEMANTICS.

(8a), with focus on the subject, is true in a situation where out of all the students taking semantics, Bill's grade is the best. If focus is on *semantics*, in contrast, the sentence describes a situation where out of all the courses Bill took, his best grade is in semantics.

To account for the ambiguity of superlatives and the role focus plays, Heim (1999) proposes the following analysis: Superlatives are formed by a superlative operator *-est* which is semantically a quantifier over degrees. This operator is restricted by a covert variable *C*, which provides a comparison class and is resolved contextually. If focus is present and makes

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[5] It has been observed that *many* can be accompanied by an overt definite article, as in *Jane regrets the many mistakes she has made*. This is in line with the view that *many* is a predicate rather than a determiner. See Solt (2009, 2015) for detailed discussion of the distribution of *many.*

[6] I use capital letters to indicate semantic focus independently of its intonational realisation.

available alternatives, these alternatives are factored in when C is resolved and C has to be a subset of the focus alternatives. In the terms of Beaver and Clark (2008), this means that *-est* shows free association with focus. The lexical entry in (9) is proposed by Heim to factor in the contribution of focus in the usual way via the squiggle operator following Rooth (1992).

(9) $[\![\text{-est } C]\!] = \lambda D_{<d,t>}.\ \exists d\ [D(d)\ \&\forall D' \in C\ [\ D' \neq D \rightarrow \neg D'(d)]$

Note that in this lexical entry for *-est*, the comparison class C is a set of degree properties (type <<d,t,>t>).[7] Being a quantifier, *-est* undergoes QR and can take local scope, i.e. internal to the host DP, or raise to a DP-external position to take non-local scope. Crucially, it is assumed that the material in the scope of *-est* determines the relation relative to which individuals are compared, which means that the members of C must have the same form as the LF sister of *-est.* With these assumptions, the two readings of superlatives discussed above can be derived as resulting from different scope of *-est.*

The absolute reading obtains from an LF where *-est* takes local scope inside its host DP, as shown in (10).[8]

(10) a. LF: John climbed [$_{\text{DP}}$ the [2 [[-est C] [1 [t_2 t_1-high mountain]]]]]
b. climb(j, ιx [$\exists d$ [mountain(x) & HEIGHT (x) $\geq d$ &
$\forall D' \in C$ [$D' \neq$ [$\lambda d'$. x is a d'-high mountain] $\rightarrow \neg D'(d)$]]]])
c. C = { $\lambda d'$. Ben Nevis is a d'-high mountain, $\lambda d'$. Ben Macdui is a d'-high mountain, $\lambda d'$. Braeriach is a d'-high mountain, ...}

In this configuration, the heights of contextually relevant mountains are compared. This is so because in the LF, the sister of *-est* is [1 [t_2 t_1-high mountain]]. In consequence, the members of the comparison class C are all of the form '$\lambda d'$. x is a d'-high mountain'. Following Szabolcsi (1986), it is assumed that x ranges over contextually relevant individuals to which the property of being a d'-high mountain can be felicitously applied, i.e. mountains. Under the downward monotonic semantics for *high* in (6), the members of C are sets of degrees consisting of all the degrees up to the respective mountain's height, e.g. C in (10c) contains the intervals (0, HEIGHT(Ben Nevis)], (0, HEIGHT(Ben Macdui)], *etc*. The denotation of the entire superlative DP is then the unique individual that figures in the member of C with the greatest maximum, i.e. the mountain whose height is the greatest.

Relative readings obtain from an LF where *-est* takes non-local scope and its LF sister does not only comprise the DP but crucially also the focused constituent. Now we also have to factor in the contribution of focus. In the relative reading of example (7) focus is on the subject, as indicated in (11).[9]

[7] In fact, C has to be a set of degree property intensions, i.e. of type <<s,<d,t>>,t>. This is necessary in order to distinguish different degree properties that happen to have the same extensions. For now, I use the extensional version for the sake of readability, but I will return to this issue in footnote 11.

[8] This derivation assumes that landing sites for QR can be created inside DPs by PRO-movement (see Heim and Kratzer, 1998, chap. 8).

[9] Following Szabolcsi (1986), I assume that the definite article is interpreted as an indefinite in relative readings of superlatives.

(11) a. LF: [[-est C] [1 [JOHN climbed A t_1-high mountain]] ~C]
b. $\exists d$ [$\exists x$[climb(j,x) & mountain(x) & HEIGHT (x) $\geq d$ &
$\forall D' \in C$ [$D' \neq$ [$\lambda d'$. John climbed a d'-high mountain] $\rightarrow \neg D'(d)$]]]
c. $C \subseteq$ {$\lambda d'$. John climbed a d'-high mountain, $\lambda d'$. Bill climbed a d'-high mountain, $\lambda d'$. Sam climbed a d'-high mountain, …}

As before, the form of the members of C is determined by the material inside the LF sister of *-est.* In addition, the squiggle operator adds the constraint that C has to be a subset of the focus alternatives, which are of the form '$\lambda d'$. x climbed a d'-high mountain', with x ranging over contextually relevant individuals. This results in a comparison class C comparing relevant persons in terms of the height of the mountains they climbed. Since the truth conditions in (11b) are fulfilled iff the maximum of the degree set given by '$\lambda d'$. John climbed a d'-high mountain' is higher than the maximum of any other degree set in C, the sentence comes out as true iff John climbed a higher mountain than any other relevant person.

In summary, the ambiguity of superlatives between absolute and relative readings can be analysed as a scope ambiguity of the superlative operator *-est*. In relative readings, focus affects truth conditions.

2.3. The positive operator POS

Building on Schwarz (2010), Romero (2015) argues that the properties discussed in the preceding subsection for the superlative operator also hold of the phonetically empty positive operator POS. Motivation for this comes from the observation that adjectives in the positive give rise to an ambiguity between absolute and relative readings, too. This is illustrated in the following example discussed by Schwarz (2010).

(12) Mia has an expensive hat.

Under the absolute reading, (12) can be paraphrased as 'Mia has a hat that is expensive for a hat'. Here the price of Mia's hat is compared to the price of hats in general. Under the relative reading, which can be paraphrased as 'Mia has a hat that is expensive for somebody like Mia to have', Mia is compared to other persons in terms of the expensiveness of their hats. Romero (2015) proposes that this ambiguity can be derived from DP-internal vs. DP-external scope of POS in analogy to absolute and relative readings of superlatives. She moreover argues that the positive form of adjectives shows the same kind of focus sensitivity as the superlative. Therefore, crucial features of the analysis of *-est* carry over to the analysis of POS. These are summarized in (13).

(13) The positive operator POS:
(i) The positive operator POS is restricted by a covert variable C providing a comparison class, which is resolved contextually.
(ii) The effects of focus are factored in when C is resolved (free association with focus in Beaver and Clark's 2008 terms).
(iii) POS can take local (DP-internal) or non-local scope (DP-external) .
(iv) The material in the scope of POS determines the form of the members of C.

To implement this analysis, I use the following lexical entry for POS, which is parallel to that of *-est* in (9).

(14) $[\![\text{POS } C]\!] = \lambda D_{<d,t>}. \exists d\ [D(d)\ \&\ d > \theta_C\ ]$

POS requires the degree property D serving as its argument to hold to a degree exceeding a contextual standard. The standard is computed by the function θ, which maps a comparison class C to a degree, taking into account the distribution of values in C (see Solt, 2011a). As for superlatives, I assume that the comparison class C is a set of degree properties.

With these assumptions, the two readings of sentence (12) above can be derived in the following way. The absolute reading is derived from an LF where POS takes DP-internal scope, as shown in (15).

(15) a. LF: Mia has [$_{DP}$ a [2 [POS C] [1 [t_2 t_1-expensive hat]]]]
b. $\exists x$ [have(m,x) & $\exists d$ [hat(x) & Expensiveness(x) $\geq d$ & $d > \theta_C$]]
c. $C = \{ \lambda d'$. h$_1$ is a d'-expensive hat, $\lambda d'$. h$_2$ is a d'-expensive hat, ...}

In this configuration, the LF-sister of POS is [1 [t_2 t_1-expensive hat]] and consequently, the members of C are of the form '$\lambda d'$. x is a d'-expensive hat', with x ranging over hats. The contextual standard that the semantics of POS refers to is determined relative to this comparison class, i.e. relative to the price of hats in general.

In the absolute reading of (12), the price of Mia's hat is compared to the price of hats owned by persons comparable to her, e.g., 3-year-old girls. This reading is derived from an LF where POS takes DP-external scope and focus is on the subject, as shown in (16). In analogy to the derivation of the relative reading of superlatives discussed above, C is a subset of the focus alternatives, which are of the form '$\lambda d'$. x has a d'-expensive hat', with x ranging over contextually relevant individuals.

(16) a LF: [[POS C] [1 [MIA has a t_1-expensive hat]] ~ C]
b. $\exists d$ [$\exists x$ [have(m,x) & hat(x) & Expensiveness(x) $\geq d$] & $d > \theta_C$]
c. $C \subseteq \{ \lambda d'$. Mia has a d'-expensive hat, $\lambda d'$. Emma has a d'-expensive hat,
$\lambda d'$. Hannah has a d'-expensive hat, ...}

Romero (2015) further observes that in relative readings, the focus associate of POS can not only be external to the host DP, as in (16), but that it can also be internal to the host DP. She discusses example (17), which has a reading under which it is true in the scenario in (18).

(17) (For what he has been giving her, now) Rockefeller gave Kate an inexpensive CAR.

(18) Scenario: Rockefeller just gave Kate a very expensive car. Still, his present compares poorly to his previous astronomically expensive presents (e.g. apartment in Manhattan, island in the Pacific, etc.)

The relevant reading of (17) can be paraphrased as 'Rockefeller gave Kate a car and this present is inexpensive compared to his other presents to her'. The comparison class is thus made up of sets of degrees to which other presents that Rockefeller gave Kate are inexpensive. We get this comparison class from an LF where POS takes DP-external scope while the focus associate is *car* inside the host DP, as shown in (19).

(19) a. LF: [[POS C] [1 [Rockefeller gave Kate a t_1-inexpensive CAR]] ~ C]
b. $\exists d$ [$\exists x$ [give(r,k,x) & car(x) & Expensiveness(x) $\leq d$] & $d < \theta_C$]
c. $C \subseteq${$\lambda d'$. Rockefeller gave Kate a d'-inexpensive car,
$\lambda d'$. Rockefeller gave Kate a d'-inexpensive apartment in Manhattan,
$\lambda d'$. Rockefeller gave Kate a d'-inexpensive island in the Pacific, ...}

Let us now apply this analysis of the positive operator to the cases of quantifier *many* under the assumption that we are dealing with the positive form of a gradable cardinality predicate.

3. Analysis

This section proposes an analysis of the quantifier *many*, where it is decomposed into three different components: *many* itself is treated as a gradable cardinality predicate, which combines with the phonetically empty positive operator. Quantificational force comes from a covert existential quantifier. It is shown that the different readings of *many* discussed in Section 1 can be derived under the assumptions about the semantics of *many* and the positive operator POS introduced in the previous section. The different readings are argued to result from different scope of POS and association with focus.

3.1 Cardinal reading

Cardinal readings are in a way the default readings that arise under the present analysis. With the assumptions introduced in the preceding section, cardinal readings result from an LF where POS takes DP-external scope. This is illustrated in (21) for sentence (20).

(20) Many students took Intro to Semantics.

(21) a. LF: [POS C] [1 [[$_{DP}$ $\varnothing$ [t_1-many students]] took Intro to Semantics]]
b. $\exists d$ [$\exists x$ [students(x) & $|x| \geq d$ & take(x, Intro-to-Semantics)] & $d > \theta_C$]
c. C = { $\lambda d'$. d'-many students took Intro to Semantics, $\lambda d'$. d'-many students took Intro to Syntax, $\lambda d'$. d'-many students took Intro to Phonology, …}

In the in LF (21a) [POS C] is extracted out of the host DP and takes sentential scope. The value of the comparison class C is contextually resolved, possibly restricted by focus. Assuming that the number of students taking Intro to Semantics is assessed with respect to the number of students in other comparable courses, C might look as shown in (21c). According to the truth conditions in (21b), the sentence then comes out as true iff the number of students taking Intro to Semantics exceeds the number that would be expected on the basis of other comparable courses. This is similar to the meaning one would get using the determiner *many*$_{\text{CARD}}$ in (4), but differs from the analysis in GQT-style in one important respect: we are now more explicit regarding the standard relative to which the number of students is considered large. It is computed on the basis of a comparison class, which is (partly) determined by the compositional semantics.

3.2 Proportional reading

We just saw that DP-external scope of POS yields cardinal readings of *many*. I now show that the proportional reading of *many* can be obtained from an LF where POS takes DP-internal scope.[10] Following the analysis of the proportional reading of *most* in Hackl (2009), I assume that in this configuration the comparison class *C* consists of the cardinalities of the pluralities denoted by the NP sister of *many.* In example (22), for instance, pluralities consisting of books on the reading list are compared in terms of how many atomic parts they have.

(22) John read many books on the reading list.

(23) a. LF: John read [∅ [2 [POS *C*] [1 [t_2 t_1-many books on the reading list]]]]
b. $\exists x$ [read(j,x) & $\exists d$ [$|x| \geq d$ & books-otrl (x) & $d > \theta_C$]]
c. $C = \{\lambda d'.\ x$ are d'-many books on the reading list: x is a plurality consisting of books on the reading list$\}$

In the LF (23a), the sister of [POS *C*] is [1 [t_2 t_1-many books on the reading list]]. Thus, the members of *C* all have the form '$\lambda d'$. *x* are *d'*-many books on the reading list'. In analogy to absolute readings of superlatives, it is assumed that *x* ranges over individuals to which the property of being *d'*-many books on the reading list can be felicitously applied. Following Hackl (2009), I assume that *C* consists of the cardinalities of all the pluralities in the denotation of 'books on the reading list'. In order to see what it means that a certain degree exceeds a standard computed relative to this comparison class, let us inspect the values in *C* and their distribution more closely. Assuming for illustration, that there are eight books on the reading list, $b_1, b_2, \ldots, b_8$, the pluralities in the denotation of 'books on the reading list' and their cardinalities are shown in (24). Consequently, *C* in this case looks as in (25).

(24)

$b_1, b_2, \ldots, b_8,$	8 of cardinality 1
$b_1\oplus b_2, b_1\oplus b_3, b_1\oplus b_4, \ldots, , b_7\oplus b_8,$	28 of cardinality 2
$b_1\oplus b_2\oplus b_3, \ldots, , b_6\oplus b_7\oplus b_8,$	56 of cardinality 3
$b_1\oplus b_2\oplus b_3\oplus b_4, \ldots, , b_5\oplus b_6\oplus b_7\oplus b_8,$	70 of cardinality 4
$b_1\oplus b_2\oplus b_3\oplus b_4\oplus b_5, \ldots, b_4\oplus b_5\oplus b_6\oplus b_7\oplus b_8,$	56 of cardinality 5
$b_1\oplus b_2\oplus b_3\oplus b_4\oplus b_5\oplus b_6, \ldots, b_3\oplus b_4\oplus b_5\oplus b_6\oplus b_7\oplus b_8,$	28 of cardinality 6
$b_1\oplus b_2\oplus b_3\oplus b_4\oplus b_5\oplus b_6\oplus b_7, \ldots, b_2\oplus b_3\oplus b_4\oplus b_5\oplus b_6\oplus b_7\oplus b_8,$	8 of cardinality 7
$b_1\oplus b_2\oplus b_3\oplus b_4\oplus b_5\oplus b_6\oplus b_7\oplus b_8$	1 of cardinality 8

(25) $C = \{$ $\lambda d'$. b_1 are d'-many books on the reading list,
$\lambda d'$. b_2 are d'-many books on the reading list, …,
$\lambda d'$. $b_1\oplus b_2\oplus b_3\oplus b_4\oplus b_5\oplus b_6\oplus b_7\oplus b_8$ are d'-many books on the reading list$\}$

[10] See Krasikova (2011) and Solt (2011b) for similar proposals.

Note that the distribution of values in C shows a particular pattern, as indicated in (24): Because there are 8 pluralities of cardinality 1, the set of degrees with maximum 1 is represented 8 times; there being 28 pluralities of cardinality 2, the set of degrees with maximum 2 is represented 28 times, and so on.[11] In general, if there are n atomic individuals of a certain kind, the number of pluralities with cardinality k is given by the binomial coefficient $\binom{n}{k}$. The distribution of values in a comparison class representing the cardinalities of the pluralities in the NP denotation corresponds to a bell curve, as illustrated in Figure 1.

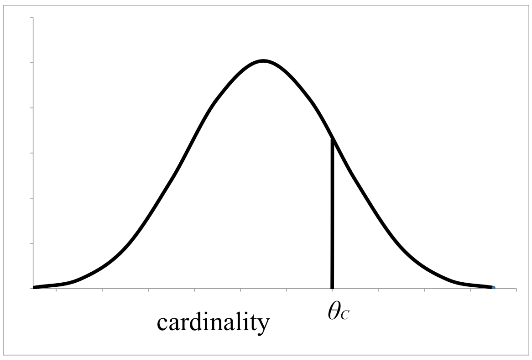

Figure 1: Distribution of values in a comparison class representing the cardinalities of the pluralities in the NP denotation

Given this distribution of values in C, the standard for 'many'ness relative to C, θ_C, is likely to be located somewhere in the rightmost third of the area enclosed by the curve, as indicated in Figure 1. In effect, the truth conditions in (23b) express that John read a plurality of books whose cardinality is high relative to the cardinalities of the members of the power set of the set of books on the reading list. This mirrors the meaning assigned to proportional *many* by the analysis in the framework of Generalized Quantifier Theory, but crucially without making reference to actual proportions.

3.2 Reverse reading

For the derivation of the reverse reading, I follow Romero (2015, 2016) and assume that it is the role that focus plays in determining the comparison class that gives the impression of a

[11] In this case, it is crucial that the comparison class consist of intensional degree properties. C in (25) should more accurately be rendered as in (i):

(i) $C = \{\ \lambda w.\lambda d'.\ b_1$ are d'-many books on the reading list in w,
$\lambda w.\lambda d'.\ b_2$ are d'-many books on the reading list in w, …,
$\lambda w.\lambda d'.\ b_1 \oplus b_2 \oplus b_3 \oplus b_4 \oplus b_5 \oplus b_6 \oplus b_7 \oplus b_8$ are d'-many books on the reading list in $w\ \}$

Using intensional degree properties is crucial to ensure that the degree properties corresponding to different pluralities with the same number of atomic elements are not equivalent. Note that e.g. (i-a) and (i-b) are different degree properties. Although the pluralities do not differ across worlds regarding the number of atomic elements, the degree properties (ii-a) and (ii-b) differ with respect to the worlds at which they are defined and are thus not equivalent (e.g., (ii-a) would be undefined at world w_{29} if the individual b_1 does not exist in w_{29}).

(ii) a. $\lambda w.\lambda d'.\ b_1 \oplus b_2$ are d'-many books on the reading list in w
b. $\lambda w.\lambda d'.\ b_3 \oplus b_4$ are d'-many books on the reading list in w

'reverse' reading. But in contrast to Romero, under the present analysis the reverse reading is derived as a special case of a cardinal reading.

As noted by Herburger (1997), the reverse reading is facilitated by placing focus on (part of) the NP sister of *many*. In Westerståhl's (1985) famous example focus is on 'Scandinavians', as indicated in (26).

(26) Many SCANDINAVIANS have won the Nobel Prize in literature.

Because focus alternatives are factored in when the comparison class C is computed, focusing *Scandinavians* has an important effect on the truth-conditions. Consider the LF (27) that we get for sentence (26) under the assumption that POS takes DP-external scope.

(27) a. LF: [[POS C] [1 [$\varnothing$ [t_1-many SCANDINAVIANS]] have won the NP] $\sim C$]
b. $\exists d$ [$\exists x$[Scandinavians(x) & $|x| \geq d$ & won(x, NP)] & $d > \theta_C$]
c. $C \subseteq$ { $\lambda d'$. d'-many Scandinavians have won the NP,
$\lambda d'$. d'-many Mediterraneans have won the NP,
$\lambda d'$. d'-many Eastern Europeans have won the NP, … }

This configuration is parallel to the adjectival case in (19) discussed in Section 2.3 above. Because [POS C] takes sentential scope and the comparison class C is a subset of the focus alternatives triggered by focus on *Scandinavians*, we get the comparison class C in (27c). With this comparison class, different world regions are compared in terms of the number of Nobel Prize winners they have produced. The truth conditions in (27b) are fulfilled in case the number of Nobel Prize winners from Scandinavia is large compared to the number of Nobel Prize winners from other parts of the world. This is the case if the Scandinavians make up a significant proportion of all the Nobel Prize winners, as is the case in the scenario in (3), discussed in Section 1, where 14 out of a total of 81 Nobel Prize winners in literature come from Scandinavia (although this is in fact hard to say unless we know where the other 67 winners come from).

Before closing this section, I would like to add a remark regarding conservativity. Westerståhl's (1985) example triggered a lot of discussion in the semantics literature, because it has been regarded as a counter-example to the generalization that determiners in natural languages are always conservative (Barwise and Cooper, 1981; Keenan and Stavi, 1986). Under the approach taken here *many* is not a determiner, so the question whether *many* obeys conservativity does not even arise.

To summarize, this section showed that the different readings can be derived under a single lexical entry of *many* as a cardinality predicate that combines with the positive operator POS. The proportional reading is derived from an LF where POS takes DP-internal scope. When POS takes DP-external scope, cardinal readings result. Reverse readings are a special case of cardinal readings that arise if (part of) the NP-sister of *many* is focused.

4. A closer look at reverse readings

Above, the reverse reading was argued to arise as a special case of a cardinal reading, where the NP sister of *many* is focused. We now compare the truth conditions derived for the reverse reading in (27) above to the ones derived from a determiner $many_{\text{REV}}$ in GQT-style, and to the truth conditions derived under the analysis of Romero (2015, 2016).

Let us first compare the truth conditions derived under the present analysis to the truth conditions in (28b) obtained from a GQT-style analysis with the determiner $many_{\text{REV}}$ with the lexical entry in (28a).

(28) a. $[\![\text{many}_{\text{REV}}]\!] = \lambda P.\lambda Q.\ |\ P \cap Q\ |:|\ Q\ | > k$, where k is a large fraction
b. $|\ \{x\text{: Scandinavian}(x)\} \cap \{x\text{: NP-winner}(x)\}\ |:|\ \{x\text{: NP-winner}(x)\}\ | > k$

Comparing (28b) and the truth conditions derived under the present analysis in (27b) above, a difference can be noted concerning the question whether it makes a difference where the non-Scandinavian Nobel Prize winners come from. In (27b) the number of Nobel Prize winners per world region enters into the computation of the standard relative to which a number counts as 'many'. The nationality of the non-Scandinavian Nobel Prize winners can therefore make a difference to the truth conditions. For (28b), in contrast, it does not seem to matter where the Nobel Prize winners who are not Scandinavians come from, since it only relates the number of Scandinavian Nobel Prize winners to the total number of Nobel Prize winners.

But we have to keep in mind a further difference between the present analysis and the one in GTQ-style concerning the question how the standard for 'many'-ness is determined. While the present analysis holds that the comparison class, which is partly determined by the grammar, plays a crucial role in computing this standard, the GTQ-style analysis is vague and just assumes that the threshold value k, above which a fraction counts as large, is determined by the context. Depending on the assumptions we make about what contextually given facts are taken into account in determining the standard, the conditions under which (28b) is true get more similar to the truth conditions in (27b). If we assume that the decision what counts as a large proportion of a set S is also influenced by the composition of S, then the nationality of the non-Scandinavian Nobel Prize winners becomes again relevant: if we are aware that Scandinavia has produced more Nobel Prize winners than most other parts of the world, the proportion of Scandinavian Nobel Prize winners to the total number of Nobel Prize winners is probably considered large. To conclude, it is not straightforward to compare the truth conditions derived under the two types of analyses, as long as the GTQ-style analysis is vague about how the contextual standard is determined.

We now turn to the analysis of Romero (2015, 2016). Following Hackl (2000), Romero analyses *many* as a gradable determiner, i.e. a determiner with an extra degree argument. But in contrast to Hackl, Romero employs two different lexical entries for *many,* $\text{MANY}_{\text{CARD}}$ for cardinal readings and $\text{MANY}_{\text{PROP}}$ for proportional readings, as shown in (29).

(29) a. $[\![\text{MANY}_{\text{CARD}}]\!] = \lambda d_{\text{d}}.\lambda P_{<e,t>}.\lambda Q_{<e,t>}.\ |\ P \cap Q\ | \geq d$, where d ranges over natural numbers
b. $[\![\text{MANY}_{\text{PROP}}]\!] = \lambda d_{\text{d}}.\lambda P_{<e,t>}.\lambda Q_{<e,t>}.\ (|\ P \cap Q\ |:|\ P\ |) \geq d$, where d ranges over fractions between 0 and 1 or percentages

For the derivation of the reverse reading, Romero uses the proportional determiner $\text{MANY}_{\text{PROP}}$. Leaving intact the rest of the analysis from above, which was in fact borrowed from Romero, the reverse reading results from an LF where POS takes DP-external scope and the NP sister of *many* is focused. Combining this with the proportional determiner $\text{MANY}_{\text{PROP}}$ yields the truth conditions in (30b) where the standard is determined relative to a comparison class C that looks like (30c).

(30) a. LF: [[POS C] [1 [[t_1-$\text{MANY}_{\text{prop}}$ SCANDINAVIANS] have won the NP]] ~ C]
b. $\exists d$ [| {x: Scandinavian(x)} $\cap$ {x: NP-winner(x)} | : | {x: Scandinavian(x)} | $\geq d$ & $d > \theta_C$]
c. $C \subseteq$ { $\lambda d'$.(|{x: Scand.(x)} $\cap$ {x: NP-winner(x)}| : |{x: Scandinavian(x)}|) $\geq d'$,
$\lambda d'$.(|{x: Mediterranean(x)} $\cap$ {x: NP-winner(x)}| : |{x: Mediterranean(x)}|) $\geq d'$,
$\lambda d'$.(|{x: Eastern Europ.(x)} $\cap$ {x: NP-winner(x)}| : |{x: Eastern Europ.(x)}|) $\geq d'$}

With this comparison class, different world regions are compared with respect to the number of Nobel Prize winners in relation to the total number of inhabitants of that region. That yields a crucial difference to the truth conditions derived under the present proposal in (27) above: in (30) not only the number of Nobel Prize winners from a certain region is taken into account, but also the size of the overall population. In effect, the smaller the total population of a region is, the fewer Nobel Prize winners are sufficient to make the corresponding sentence true. Cohen (2001) and Romero (2015) argue that this move is necessary to adequately capture the truth conditions of the sentence. Contrasting the truth conditions of the minimally different sentences in (31), Cohen (2001: 48) remarks: "It may be sufficient for as few as two or three Andorrans to have won the Nobel Prize in literature for [(31b)] to be true; but such a small number would not be enough for the truth of [(31a)]."

(31) a. Many SCANDINAVIANS have won the Nobel Prize in literature.
b. Many ANDORRANS have won the Nobel Prize in literature.

Different intuitions, however, have been reported regarding the precise conditions under which Westerståhl's Nobel Prize winner-sentence is true, and in particular regarding the question whether the total number of individuals in the NP denotation is taken into account. According to Eckardt (1999:175), it does not matter: "The sentence is even true if the nation in question is the biggest on earth, and the ratio of winners per nation is even rather bad."

Given these diverging intuitions about the truth conditions of Westerståhl's example, without an in depth empirical investigation it is impossible to decide whether an adequate semantics for the reverse reading of a sentence of the form *many A are B* does indeed have to make reference to the proportion | $A \cap B$| : | A |. But I would like to point out a possibility how to accommodate the impression that the total number of individuals in the NP denotation matters to the truth conditions of Westerståhl's example, if it turns out to be correct. So far, we have made only one specific assumption about the function θ determining the contextual standard to which POS makes reference, namely that it does so on the basis of a comparison class C. And one position would indeed be that the context dependency of the truth conditions of sentences with positive forms of adjectives all boils down to the comparison class C: once C is fixed, the standard is also fixed. Under this view, θ_C always yields the same degree for all contexts (for discussion of a contextually-stable threshold function θ used in the semantics of *many* see Fernando and Kamp, 1996; Schöller and Franke, 2015). But an alternative view could maintain that θ_C is itself context-dependent, i.e. what value θ yields for the same C might differ from context to context. If we assume such a contextually-variable function θ_C considerations about how many Nobel Prize winners one would expect to come from a certain region could enter into the computation of the standard for 'many'ness, such that the standard would be higher for populous parts of the world than for parts with smaller population.

In any case, there are examples that clearly have a reverse reading where the total number of individuals in the NP denotation does not matter. A case in point is sentence (32a), which can be paraphrased as 'A high proportion of the things Peter got for his birthday are books'. Corresponding truth conditions are derived from an LF where POS takes DP-external scope and the comparison class C is restricted by focus on the NP sister of *many,* as in (27) above. In general, attributing reverse readings to focus effects can account for types of reverse readings that the GQT-style analysis cannot accommodate. This is the case in (32b), where focus is inside the temporal modifier. The sentence has a reading under which a sensible person could still board an airplane, namely that most airplanes that crash do so when landing. This reading can be derived with the tools the present analysis makes available, namely by letting the focus inside the temporal modifier restrict the comparison class C, which will then compare the number of crashes in different stages of a flight.

(32) a. Tom got many BOOKS for his birthday.
b. Many airplanes crash when LANDING.

A fact supporting the view that the reverse reading arises as a cardinal reading rather than a proportional reading comes from the observation that the reverse reading arises in the same grammatical contexts as cardinal readings, and is impossible in contexts where only proportional readings are available. The grammatical constraints governing the distribution of the different readings is the topic of the next section.

5. Distributional restrictions of the different readings

It is well known that the cardinal and proportional reading of *many* are restricted to certain grammatical contexts, as are the interpretations of other so-called weak quantifiers, like cardinal numerals and *some* (Milsark, 1977; Partee, 1989 among many others). When a *many*-phrase serves as the subject of an individual-level predicate, as in (33a), only the proportional reading is available. For *many*-phrases as subject of stage-level predicates and objects, in contrast, both the cardinal and the proportional reading is possible, cf. (33b) and (33c). *Many*-phrases in *there* sentences, finally, receive only the cardinal reading, cf. (33d).

(33)	a. Many Huskies have blue eyes.	#cardinal reading, ✓proportional reading
	b. Many students took Intro to Semantics.	✓cardinal reading, ✓proportional reading
	c. Carl invited many semanticists.	✓cardinal reading, ✓proportional reading
	d. There are many children in the garden.	✓cardinal reading, #proportional reading

Under the present analysis of *many*, a possible way to handle the distribution of cardinal and proportional readings in the spirit of Diesing (1992) would be the following. Let us assume, following Diesing, that genuine quantifiers are obligatorily interpreted at the level of IP, while a default existential closure operator binds any unbound (individual) variables at the level of vP. At LF, subject of stage-level predicates and objects can either occupy their base generated position inside vP, or, if they are genuine quantifiers, move to the level of IP. Subjects of individual-level predicates are base generated at the level of IP, whereas subjects of *there*-sentences are obligatorily interpreted vP-internally. Combining these assumptions with the present analysis, the quantificational force of *many*-phrases can come from different sources, depending on their structural position. Keeping the assumption from above that there is a phonetically empty existential determiner ∅, *many*-phrases that are interpreted at the level of IP involve ∅. In contrast, *many*-phrases that occupy a vP-internal position at LF get their existential force from the default existential closure operator.

We can account for the observed restrictions on the readings of *many* if we make a further assumption about the possible interpretation sites of the positive operator POS. Assume that the positive operator POS cannot move out of the restrictor of the genuine quantifier ∅, while being a degree quantifier, it has to be interpreted at the IP-level and thus raise above the existential closure operator if it originates from a vP-internal *many*-phrase.[12] With this assumption, there is a one-to-one correspondence between the reading and the source of the quantificational force of a *many*-phrase: since under the present analysis the proportional reading corresponds to DP-internal scope of POS, it results from a *many*-phrase involving ∅. The cardinal reading, corresponding to DP-external scope of POS, results from a vP-internal *many*-phrase that is subject to existential closure.

The pattern shown in (33) above now follows. Since *many*-phrases as subjects of individual-level predicates occupy a position at the IP-level, they obligatorily involve ∅.[13] This in turn means that POS can only be interpreted DP-internally, resulting in the proportional reading. *Many*-phrases as subjects of stage-level predicates and objects, in contrast, can occupy different positions at LF. If they involve ∅, they are interpreted at the IP-level, resulting in the proportional reading. Additionally they can also be interpreted vP-internally, in which

[12] This claim should not be restricted to POS, but should rather hold of degree operators in general. While it is difficult to judge whether this restriction also holds for the comparative operator *-er*, because scope of *-er* relative to ∃ does not make a truth-conditional difference, there is evidence that it applies to *-est*. First, it is well known that proportional *most* is a so-called strong determiner, i.e. *most*-phrases cannot occur in *there*-sentences. Second, only the proportional reading seems to be available for *most*-phrases as subjects of individual-level predicates. The different readings of *most* thus seem to show the same distributional restrictions as the readings of *many*. Under the analysis of Hackl (2009), where the proportional reading of *most* results from an LF where the superlative operator *-est* takes DP-internal scope, the restrictions of *most* would also follow from the present assumptions about the correspondence between the source of quantificational force and the scope options of degree operators.

[13] More precisely, *many*-phrases interpreted at the IP-level are assumed to involve ∅ if they receive an existential interpretation. They can also be interpreted generically, as is well known from bare plurals. The generic cardinal reading (de Hoop, 1992) is illustrated in sentence (i), which expresses a statement about all groups of people reaching a considerable number.

(i) Many people don't fit into this room.

The comparison with readings available for bare plurals raises the question why the phonetically empty existential determiner ∅ does not seem to be available for bare plurals. Speculating on possible reasons goes beyond the scope of the present paper.

case POS raises above the existential closure operator, giving rise to the cardinal reading. For *many*-phrases in *there*-sentences, only a vP-internal position is possible, making only the cardinal reading available. The structures assumed to underlie the proportional and the cardinal reading are schematized in (33).

(34) a. [$_{IP}$ [$_{DP}$ ∅ [[POS *C*] [1 … t_1-many …]]] …] proportional reading
b. [$_{IP}$ … [[POS *C*] [1 … $\exists_x$ [$_{vP}$ … t_1-many *x* …]]]] cardinal reading

Let us now turn to the reverse reading. Herburger (1997) observes that the reverse reading is restricted to the same grammatical contexts as the cardinal reading. As illustrated in the following paradigm, the reverse reading cannot arise with individual-level predicates, whereas it is possible with stage-level predicates as well as for objects, and is perfectly available in *there*-sentences.

(35) a. Many COOKS know how to make a soufflé.
#'A high proportion of the people that know how to make a soufflé are cooks.'
b. Many COOKS applied.
'A high proportion of the applicants are cooks.'
c. Carl interviewed many COOKS.
'A high proportion of the people Carl interviewed are cooks.'
d. There are many speakers of Basque THAT ARE CITIZENS OF SPAIN.
'A high proportion of Basque speakers are citizens of Spain.'

Under the present analysis, this distribution of the reverse reading is entirely expected, since the reverse reading is derived as a special instance of the cardinal reading, i.e. POS taking DP-internal scope, in which (part of) the NP-sister of *many* is focused. Under the assumption from above that the cardinal reading arises form the configuration in (33b), a *many*-phrase is predicted to give rise to the reverse reading only if it is interpreted in a vP-internal position, which is subject to existential closure. Under the analysis of Diesing (1992), a vP-internal interpretation is obligatory for subjects of *there*-sentences, possible for objects and subjects of stage-level predicates, but impossible for subjects of individual-level predicates. This accounts for the distribution of the reverse reading.

5. Conclusion

This paper explored a uniform analysis of the so-called quantifier *many*, where *many* is decomposed into a gradable cardinality predicate and the positive morpheme POS. It was shown that the various readings that have been observed for *many* can be derived under this analysis. The different readings were argued to arise from different scope of POS and free association with focus. The proportional reading is generated from an LF where POS takes DP-internal scope. If POS takes non-local scope, cardinal readings are derived, with reverse readings being a special case arising from association with focus. This improves on existing accounts, which either employ more than one lexical entry for *many* (Romero 2015, 2016) or do not specify a compositional implementation (Solt 2009).

Under the present analysis, *many* always operates on a cardinality scale, which means that the degrees *many* takes as arguments are invariably natural numbers. This contrasts with the view that proportional *many* operates on a scale of proportion, i.e. that the degrees it takes as arguments are rational numbers between 0 and 1, or alternatively percentages (Solt, 2018). More work is needed to investigate whether the kind of data that seem to require a scale of proportion can be accommodated under the present analysis.

The analysis presented in this paper contributes to the enterprise of quantifier decomposition. In the spirit of Hackl (2000, 2009), it is shown that ambiguities that are puzzling from a GQT perspective follow if expressions that appear to be quantifying determiners are decomposed and analysed with the tools made available in a degree-semantic framework.

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I want to, but…

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Abstract. I want to see the concert, but I don't want to take the long drive. Both of these desire ascriptions are true, even though I believe I'll see the concert if and only if I take the drive. Yet they, and *strongly conflicting desire ascriptions* more generally, are predicted incompatible by the standard semantics, given two standard constraints. There are two proposed solutions. I argue that both face problems because they misunderstand how what we believe influences what we desire. I then sketch my own solution: a *coarse-worlds* semantics that captures the extent to which belief influences desire. My semantics models what I call *some-things-considered* desire. Considering what the concert would be like, but ignoring the drive, I want to see the concert; considering what the drive would be like, but ignoring the concert, I don't want to take the drive.

Keywords. Desire ascriptions, strongly conflicting desire ascriptions, coarse worlds, some-things-considered desire.

1. Introduction

I want to pass, but I don't want to study; I want to eat pizza, but I don't want heartburn; I want to see the concert, but I don't want to take the long drive. These are pairs of *strongly conflicting desire ascriptions*. Standard accounts of 'want' wrongly predict that they're incompatible.

Say that ⌜A wants p⌝ and ⌜A wants q⌝ *conflict* when A believes that p will obtain only if q does not. Say that ⌜A wants p⌝ and ⌜A wants q⌝ *strongly conflict* when A believes that p will obtain if and only if q does not.

Here's an example. The Who are performing tonight, and Al's parents are deciding whether to take the long drive to the concert. Al knows that he'll see the concert only if he takes the drive, and he knows that he'll see the concert if he takes the drive. Al loves The Who, but he gets very carsick, and the drive isn't at all worth it. Al begs his parents to not take the drive.

(1) Al wants to see the concert.

(2) But Al doesn't want to take the long drive.[2]

Intuitively, both (1) and (2) are true, even though they strongly conflict (Al believes that (p) he'll see the concert if and only if it's not the case that (q) he doesn't take the drive).

Strongly conflicting desire ascriptions are common. Yet all of the standard semantics, given

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[2]I'll be talking about the prominent, neg-raising reading of (2): Al wants not to take the long drive.

two standard constraints, predict that strongly conflicting desire ascriptions are incompatible. The standard semantics form a class: they all treat ‘want’ like a deontic modal.[3,4] I can’t show here that all contemporary, deontic modal-style semantics for ‘want’, with the two constraints, make strongly conflicting desire ascriptions incompatible. What I can do is give a feel for the problem with a case study: a best-worlds semantics for ‘want’.[5]

I am not the first to notice that (merely) conflicting *desires* are puzzling, or that (merely) conflicting desire *ascriptions* are a problem for *some* of the standard semantics.[6] I’m focusing on strongly conflicting desire ascriptions—and by extension, strongly conflicting desires—because strongly conflicting desire ascriptions pose a problem for *all* of the standard semantics, given the two standard constraints. Two non-standard accounts have been developed that make strongly conflicting desire ascriptions compatible (each drops one of the two constraints). But, I argue, each faces problems elsewhere. Both misjudge the extent to which what we believe influences what we desire. The first non-standard account, like the standard account, overestimates it. The second non-standard account underestimates it.

After discussing the problem and the two proposed solutions, I sketch my own: a *coarse worlds* semantics, designed to model what I call *some-things-considered* desire. My account gives an intuitive characterization of how our desires lead to strongly conflicting desire ascriptions, and it accurately reflects the extent of belief’s influence on desire.

2. Case study: a best-worlds semantics for ‘want’

We have a modal base f and an ordering source g. Both take a world w and an agent A as arguments (and a time, strictly speaking). The modal base returns a set of worlds. The ordering source returns a set of propositions.[7] (I’ll sometimes use ‘modal base’ and ‘ordering source’ to refer to the functions and sometimes to refer to their values.) The ordering source determines a preorder $\preceq_{g(\mathrm{A},w)}$ on worlds, and $\textsc{best}(\mathrm{A},w,f,g)$ is the subset of $f(\mathrm{A},w)$ that is minimal according to $\preceq_{g(\mathrm{A},w)}$.[8] Here is the form of the semantics:

$$\textit{Best-worlds semantics.}\ [\![\text{A wants p}]\!]^{w,f,g} = 1 \text{ iff } \forall u \in \textsc{best}(\mathrm{A},w,f,g)\text{: } [\![\text{p}]\!]^{u,f,g} = 1.$$

[3]These semantics include: an “other things equal” semantics (Heim, 1992), a variant of a best-worlds semantics (Portner, 1997), an “absolute preference” semantics (Geurts, 1998), a decision-theoretic semantics (van Rooij, 1999; Levinson, 2003; Lassiter, 2011), a contrastive semantics (Villalta, 2008). Deontic modal analogs are given by, e.g. Goble (1996), Lassiter (2011) (decision-theoretic); Jackson (1985), Cariani (2013) (contrastive). A caveat: a semantics with a probability function makes desire ascriptions incompatible not when A merely believes that p will obtain if and only if q does not, but when she is *certain* of it.

[4]There’s another prominent approach to ‘want’, traditional in the philosophy literature, and recently proposed by Condoravdi and Lauer (2016) (Moltmann (2013) has a related approach). Roughly: ⌜A wants p⌝ is true iff A has a desire that is satisfied in all and only the p-worlds. Strongly conflicting desire ascriptions are compatible on this approach, but it has its own problems (see Fara (2013) and Braun’s (2015) reply to Fara).

[5]Kratzer (1981), Giorgi and Pianesi (1997), von Fintel (1999).

[6]See e.g. Davis (1984), Jackson (1985), van Rooij (1999), Levinson (2003).

[7]I’m roughly following von Fintel in presenting the best-worlds semantics.

[8]$u \preceq_{g(\mathrm{A},w)} v$ iff $\{p \in g(\mathrm{A},w) : v \in p\} \subseteq \{p \in g(\mathrm{A},w) : u \in p\}$. $\textsc{best}(\mathrm{A},w,f,g) = \{u \in f(\mathrm{A},w) : \neg\exists v \in f(\mathrm{A},w), v \prec_{g(\mathrm{A},w)} u\}$. On this definition, ‘best’ means ‘none better’. I make the limit assumption (Lewis, 1973), which entails that $\textsc{best}(\mathrm{A},w,f,g)$ is non-empty if $f(\mathrm{A},w)$ is non-empty.

This is just the form. We need to say what the modal base and ordering source are.

Start with the modal base. Which worlds are in the modal base when we evaluate ⌜A wants p⌝? In other words, whether ⌜A wants p⌝ is true depends on whether p is true in certain worlds. Which? Presumably not *all* worlds. Say that I want sushi. Somewhere out there in the total space of worlds eating sushi carries a lifetime prison sentence, yet worlds where it does are irrelevant to my desire. They're not possibilities that I take seriously. I believe that eating sushi is legal, so worlds where it isn't don't figure into my desire for sushi.

Along these lines, Stalnaker suggests that "wanting something is preferring it to certain relevant alternatives, the relevant alternatives being those possibilities that the agent believes will be realized if he does not get what he wants" (Stalnaker, 1984: p. 89). You might translate this thought into the semantics by identifying the modal base with the set of worlds compatible with what the agent believes—the agent's belief set.[9] And indeed it's standard to identify the modal base with the belief set, or a close relative.[10] (The modal base actually can't *always* be the belief set (Heim, 1992). In particular, it can't be the belief set when the agent either believes p or believes $\neg p$. I won't discuss such cases, so we'll only need to settle what the modal base is like when the agent believes neither p nor $\neg p$.)

> *Constraint: belief set modal base.* $[\![\text{A wants p}]\!]^{w,f,g}$ is defined only if $f(\text{A},w) =$ A's belief set in w (when A in w believes neither p nor $\neg p$).

What about the ordering source? On what basis does it rank the worlds for desire ascriptions? On the basis of the agent's desires. That much is universally accepted. What's not quite universally accepted, although still standardly assumed, is that the ordering source ranks worlds based on the agent's *total desire state*.[11] An ordering source ranks worlds based on the agent's total desire state when it contains *every* proposition that counts in favor of a world in the agent's eyes. (When it contains *some* such propositions, it ranks worlds based on *part* of her desire state.)

> *Constraint: unique (total desire) ordering source.* $[\![\text{A wants p}]\!]^{w,f,g}$ is defined only if $g(\text{A},w)$ represents A's total desire state in w.

Combining the semantics with the two constraints gives us:

> *Simplified, informal truth conditions.* ⌜A wants p⌝ is true iff p is true in all of the best worlds in A's belief set, as ranked by A's total desire state.

Let's see why these truth conditions make strongly conflicting desire ascriptions incompatible.

[9] Heim (1992) also uses the presupposition behavior of 'want' to motivate using the belief set.

[10] E.g. Heim (1992), Giorgi and Pianesi (1997), Portner (1997), Geurts (1998), von Fintel (1999), Giannakidou (1999), van Rooij (1999), Levinson (2003), Lassiter (2011), Pearson (2016) all identify the modal base with the belief set or a close relative (at least when A believes neither p nor $\neg p$).

[11] So far as I know, only Levinson (2003) and Crnič (2011) have denied that the ordering source ranks worlds based on the agent's total desire state. Everyone else accepts it (some implicitly, others explicitly).

2.1. Predicting that strongly conflicting desire ascriptions are incompatible

Al believes that he'll see the concert if and only if he takes the drive, which will make him sick.

(1) Al wants to see the concert.

(2) Al doesn't want to take the long drive.

(1) and (2) are both true. But that's not what we predict. If (1) and (2) are both true, then the truth conditions say that Al both sees the concert and doesn't take the drive in the best worlds in his belief set. But Al believes that he'll see the concert if and only if he takes the drive: there aren't any worlds in his belief set where Al both sees the concert and doesn't take the drive.[12]

More generally, we predict that all strongly conflicting desire ascriptions are incompatible: ⌜A wants p⌝ and ⌜A wants q⌝ are both true if and only if among the possibilities that A takes seriously (the worlds in A's belief set), the best are those where *p* and *q* both obtain. But by definition, if ⌜A wants p⌝ and ⌜A wants q⌝ conflict, then A believes that *p* will obtain if and only if *q* does not—she doesn't take seriously the possibility that *p* and *q* will both obtain. The agent's beliefs are making strongly conflicting desire ascriptions incompatible—they're influencing the modal base too much.

2.2. Two ways to make strongly conflicting desire ascriptions compatible

Given the belief set modal base and unique ordering source constraints, the best-worlds semantics wrongly predicts that strongly conflicting desire ascriptions are incompatible. There are two obvious ways to make things right: drop the unique ordering source constraint or drop the belief set modal base constraint. Both have been proposed, and both do make strongly conflicting desire ascriptions compatible. But, as I argue in sections §3 and §4, both face problems elsewhere. These problems stem from a misunderstanding of how what we believe influences what we desire.

3. Drop the unique ordering source constraint?

Intuitively speaking, what is happening when Al wants to see the concert *and* wants to avoid the drive? What is happening when an agent wants two things and believes that one will come about if and only if the other does not? Maybe the agent has conflicting values. Al values hearing good music. He also values avoiding sickness. When Al believes that one of these values will be realized if and only if the other is not, desire ascriptions strongly conflict. You might base your account of 'want' on this picture of values by saying that desire ascriptions are true or false *relative to a value*. Relative to Al's value of having hearing good music, (1), 'Al wants to see the concert', is true; relative to his value of avoiding sickness, (2), 'Al doesn't want to take the drive', is true.

[12]This amounts to a contradiction if we assume what's entirely plausible: that Al's beliefs are consistent, in which case there will be best worlds in his belief set (see footnote 8 for details).

To implement truth relative to a value in our semantics, we need to represent some things that the agent values without representing them all. In other words, we need to enable ordering sources to represent only part of the agent's desire state: we need to drop the (unique) total-desire ordering source constraint. Levinson (2003) and Crnič (2011) propose to do this by letting the ordering source vary by context:[13]

> *Constraint: variable (partial-desire) ordering source.* $[\![\text{A wants p}]\!]^{w,f,g}$ can be defined even if $g(\text{A},w)$ represents just some part of A's desire state in w.

Both (1) and (2) need true readings. What does that take? The variable ordering source view says that in a given conversation, there are multiple ordering sources that different contexts determine, multiple ordering sources that are *available* for evaluating a given desire ascription in a given conversation. A desire ascription has a true reading when evaluated against an ordering source that is available for evaluating that ascription.

Suppose that there are two ordering sources available for evaluating (1) and (2). One of them, g_1, represents Al's value of hearing good music; the other, g_2, represents his value of avoiding sickness. In Al's belief set, Al sees the concert in the g_1-best worlds, giving (1) a true reading, while in the g_2-best worlds, Al doesn't take the drive, giving (2) a true reading.

The crux of the variable ordering source view is: extra ordering sources, extra readings. Before, at most one of two strongly conflicting desire ascriptions could have a true reading, and now both can. However, along with these extra readings that we want, we get others that we don't.

3.1. Overgeneration threatens the variable ordering source view

Consider:

(3) Al wants to take the drive.

(3) has no true reading here: Al is kicking and screaming, begging to not go. But the variable ordering source view has just said that there's an available ordering source, g_1, which gives (3) a true reading. Because g_1 makes (1) true, it ranks concert-worlds best in Al's belief set. Yet the concert-worlds *are* the drive-worlds in his belief set, so g_1 ranks drive-worlds best in Al's belief set: (3) is true relative to g_1. We've overgenerated.

[13] Three things to note. First, neither Levinson nor Crnič give a best-worlds semantics (Levinson's semantics is decision-theoretic, and Crnič is noncommittal among the deontic-modal-style semantics). My objection to the variable ordering source view in §3.1 also applies to the other deontic-modal-style semantics. Second, van Fraassen (1973) and von Fintel (2012) propose an analog of the variable ordering constraint for 'ought'. Third, instead of having ordering sources vary by context, you could build extra orderings into the semantics. Let $\mathscr{G}$ be a set of ordering sources. $[\![\text{A wants p}]\!]^{w,f,\mathscr{G}} = 1$ iff $\exists g \in \mathscr{G}\colon \forall u \in \text{BEST}(\text{A},w,f,g)\colon [\![\text{p}]\!]^{u,f,\mathscr{G}} = 1$. $[\![\text{A wants p}]\!]^{w,f,\mathscr{G}}$ is defined only if, for every $g \in \mathscr{G}$, $g(\text{A},w)$ represents at least some of A's desire state in w. (For analogous approaches to 'ought', see e.g. Horty (2003), von Fintel (2012), and Cariani (2013).) This view makes strongly conflicting desire ascriptions compatible, but it's susceptible to the objection to the variable ordering source view that I give in §3.1.

(If the concert were enjoyable enough to be worth the drive, we could get a true reading of (3): Al might say to his parents that he wants to take the drive to convince them to go to the concert. This is not the case as we've set it up though.)

We can't conclude that the variable ordering source view is wrong. Because it posits variability in a contextual parameter, it is flexible. Maybe it can give principled constraints according to which g_1 is *not* available for evaluating (3), even though it is available for evaluating (1). With such constraints, we wouldn't overgenerate. For now, I'll operate as if we don't have such constraints, and I'll return to the issue in §7.

3.2. Lesson

Because we've continued to use the belief set modal base, the agent's beliefs continue to influence the modal base too much. Al believes that he'll see the concert if and only if he takes the drive—in his belief set, the concert-worlds are the drive-worlds. The ordering source draws only on worlds in the modal base—only on worlds in the belief set—so it can't distinguish the concert from the drive. We need to lessen the influence of the agent's beliefs on the modal base.

4. Drop the belief set modal base constraint?

A natural way to lessen the influence of the agent's beliefs on the modal base is to let the modal base contain worlds outside of the agent's belief set:

> *Constraint: beyond-belief set modal base.* $[\![\text{A wants p}]\!]^{w,f,g}$ can be defined when $f(\text{A},w)$ contains worlds outside of A's belief set in w (even if A in w believes neither p nor $\neg p$).

If we adopt the beyond-belief set modal base constraint, we again make unacceptable predictions, although now we'll do so because the agent's beliefs influence the modal base too *little*.

If we want our modal base to reach beyond the belief set, we need to give a principled answer to the question *which worlds outside of the belief set are in the modal base?* Villalta gives a principled answer.[14] Let's look at what she says.

4.1. Villalta's answer

We know that if the modal base is the belief set, at most one of two strongly conflicting desire ascriptions can be true: if ⌜A wants p⌝ and ⌜A wants q⌝ are both true, then p-and-q-worlds are best in the belief set, but if ⌜A wants p⌝ and ⌜A wants q⌝ strongly conflict, there aren't any p-and-q-worlds in the belief set. If the modal base isn't the belief set, there can be p-and-q-worlds in the modal base: there is no *structural* obstacle to two strongly conflicting desire ascriptions

[14]The other authors who propose a beyond-belief set modal base are Asher (1987), Anand and Hacquard (2013), and Rubinstein (2017). Anand and Hacquard adopt Villalta's view, Asher doesn't specify which worlds are outside of the belief set, and although Rubinstein says in a particular case which worlds are outside the belief set, she doesn't give a principled answer to the question of which worlds outside the belief set are in the modal base.

both being true. Nonetheless, if we use Villalta's modal bases, most desire ascriptions come out false, strongly conflicting or not.

Villalta's semantics is contrastive, so her modal bases are built out of the contextually salient contrast class. If *p*, *q*, and *r* make up the contrast class for ⌜A wants p⌝ in a given context, then the modal base is the union of *p*, *q*, and *r*.

Consider (1), 'Al wants to see the concert', evaluated against a contrast class that's just *Al sees the concert* and *Al doesn't see the concert*. If (1) is true, the best worlds in this set must all be concert-worlds. (This is what's predicted by both the best-worlds semantics and Villalta's.[15]) It just can't be, though, that all of the best worlds in this set are concert-worlds. The possible ways for Al to *not* see the concert are too varied. In some worlds where he doesn't see the concert, The Who perform in his living room. In others, John Lennon and George Harrison have been resurrected from the dead, The Beatles are reunited, and *they* perform in Al's living room.[16]

When we evaluate ⌜A wants p⌝, we can't concern ourselves with *every* way that *p* and the relevant contrast propositions can come about. If we do, only rarely will all of the best worlds be *p*-worlds. With Villalta's modal bases, most desire ascriptions will come out false. The agent's beliefs are influencing the modal base too *little*: doxastically outrageous possibilities have nothing to do with our desires. This is how we motivated the belief set modal base in the first place: worlds where I'm imprisoned for eating sushi have nothing to do with my desire for eating sushi, just as worlds where Lennon and Harrison are resurrected have nothing to do with Al's desire to go to the concert.

We need a principled answer to the question *which worlds outside of the belief set are in the modal base?* Villalta's answer doesn't succeed, but that doesn't mean that no answer could. I'll now suggest a different answer and two ways to flesh it out. Neither succeeds.

4.2. A simple, incomplete answer

The problem with the belief set modal base was that (1), 'Al wants to see the concert', and (2), 'Al wants to take the drive', couldn't both be true because there aren't worlds in Al's belief set where he both sees the concert and doesn't take the drive. There's an obvious fix: take Al's belief set and add worlds just like those in his belief set, except that in the new worlds, Al sees the concert *and* doesn't take the drive. Of course, Al most desires going to the concert without taking the drive, so these concert-no-drive-worlds are best in the new modal base. If the new modal base is available for evaluating both (1) and (2), then both have true readings.

But consider a different case. Jo is ill. Her doctors may give her antibiotics—whether she wants them or not. Jo herself wouldn't choose to have them. She believes that she can't be cured.

[15] See p. 479, where Villalta defines her preference relation: it is effectively a best-worlds approach.

[16] The problem isn't with the *Al sees the concert/Al doesn't see the concert* contrast class. If it were instead e.g. *Al sees the concert/Al stays home*, there would still be worlds where The Who perform in his living room.

(4) Jo wants the doctors to give her antibiotics.

(4) has no true reading. Yet we can give (4) a true reading with a modal base that goes outside of the agent's belief set: take Jo's belief set and add worlds just like those in her belief set, except that in the new worlds, she gets antibiotics *and* is cured. Of course, being cured is better than not, so these *antibiotics*-cured-worlds are best in the new modal base. If the new modal base is available for evaluating (4), then (4) is wrongly predicted to have a true reading.

The agent's beliefs are again influencing the modal base too little. Jo doesn't want to be given antibiotics *because* she believes they can't cure her: if the modal base contains worlds where she is cured by antibiotics, we'll make the wrong predictions about her attitude towards antibiotics.

The simple, incomplete answer is simple because it gives us a simple way to build a modal base to make (1) and (2) compatible. The simple, incomplete answer is incomplete because it doesn't tell us why we get to add concert-no-drive-worlds to Al's belief set but not antibiotics-cured-worlds to Jo's. It doesn't give us a complete, principled answer to the question *which worlds outside of the belief set are in the modal base?* I'll now make two attempts to complete the incomplete answer. Both fail.

4.2.1. An attempt at completing the simple, incomplete answer: conjunction-introduction

Here's a more complete answer—a *conjunction-introduction* answer: when ⌜A wants p⌝ and ⌜A wants q⌝ are both true and there aren't any *p*-and-*q*-worlds in A's belief set, then the modal base is A's belief set, plus some *p*-and-*q*-worlds. This answer delivers Al's belief set, plus concert-no-drive-worlds (because both 'Al wants to see the concert' and 'Al doesn't want to take the drive' are true), but it doesn't deliver Jo's belief set, plus antibiotics-cured-worlds (because 'Jo wants antibiotics' is not true), just as we wanted. However, there are two problems.

First, the conjunction-introduction answer is itself incomplete: it works backwards from what the right predictions are to what the modal base must be. We want to go the other way around. We want to give a principle for generating the modal base that yields the right predictions.

Second, the conjunction-introduction answer is not in general true. There is a kind of case of strongly conflicting desire ascriptions where the conjunction-introduction answer simply makes the wrong predictions. Consider Lu, who believes that she may be served one of two drinks tonight: either a champagne or a port. Lu is big fan of both. She says:

(5) I want to drink the champagne.

(6) I also want to drink the port. (I'm excited to see what they serve!)

(7) But of course I don't want to drink the champagne *and* the port. That would ruin both.

(5) and (6) are true, and there aren't any champagne-and-port-worlds in Lu's belief set. The conjunction-introduction answer tells us to add to Lu's belief set worlds where she drinks

port *and* champagne, banking on these conjunction worlds being best in the new modal base. They're not. Drinking champagne and port would ruin both! The conjunction worlds are *worst* in the new modal base.[17] (5) and (6) are wrongly predicted false.

4.2.2. A different attempt at completing the simple, incomplete answer: partly belief-based

We've seen that if we want to use a modal base that's not the belief set, we risk the agent's beliefs influencing the modal base too little. We don't have to throw out the baby with the bath water, though. We can use a modal base that's not the belief set and still use the agent's beliefs to influence the modal base to *some* extent.

Think of the belief set as the set of worlds that an agent thinks are viable candidates for actuality. All worlds outside the belief set are unviable candidates. Nonetheless, some worlds outside of the belief set are less viable than others. According to Al, worlds where Lennon and Harrison are resurrected are unviable candidates for actuality, as are worlds where Al sees the concert without driving. Both kinds of worlds are outside of his belief set. Nonetheless, Al thinks that worlds where Lennon and Harrison are resurrected are *less* viable candidates than worlds where Al sees the concert without driving. Put another way: Al would be less surprised to learn that he could see the concert without driving than he would be to learn that Lennon and Harrison were resurrected.

You might use viability to complete the incomplete answer. Here's a *partly belief-based* answer to the question *which worlds outside the belief set are inside the modal base?* Worlds that the agent thinks are unviable candidates for actuality can be inside the modal base, but worlds that the agent thinks are *too* unviable can't be inside the modal base.

We want the partly belief-based answer to give (1), 'Al wants to see the concert', and (2), 'Al doesn't want to take the drive', true readings without giving (4), 'Jo wants the doctors to give her antibiotics', a true reading. We want to allow the modal base that is Al's belief set, plus concert-no-drive-worlds, but disallow the modal base that is Jo's belief set, plus antibiotics-cured-worlds. So we'd need it to be that Al thinks that concert-no-drive-worlds are *more* viable candidates for actuality than Jo thinks antibiotics-cured-worlds are. But we can just suppose that this isn't the case. We can suppose that Jo would be *less* surprised to learn that she could be cured with antibiotics than Al would be to learn that he could see the concert without driving.

4.3. Lesson

In trying to reduce the influence of the agent's beliefs on the modal base by letting the modal base contain worlds outside of the agent's belief set, we make wrong predictions. And we do so *because* we have reduced the influence of the agent's beliefs too much. The possibility that The Who perform in Al's living room is irrelevant to Al's desire to see the concert *because* Al

[17] The conjunction-introduction answer also fails when the prejacents of two true desire ascriptions are incompossible (Davis (1984), Fara (2013) give such cases). Van Rooij (1999) and Levinson (2003) also point out that 'want' is not closed under conjunction.

believes that he can only see The Who perform if he sees the concert; the possibility that Jo is cured by antibiotics has nothing to do with Jo's desire to not be given antibiotics *because* she believes that antibiotics can't cure her; the possibility that Al drinks port with champagne has nothing to do with his desire to drink port, and champagne, respectively, *because* he believes that he won't drink them together. Doxastic impossibilities are irrelevant to the agent's desires.

If our modal bases for desire ascriptions contain possibilities that are irrelevant to the agent's desires, we shouldn't expect to make the right predictions—we shouldn't expect to make the right predictions if we adopt the beyond-belief set modal base constraint.

5. Interim summary

The standard, deontic modal-style semantics for 'want', given the two standard constraints, make strongly conflicting desire ascriptions incompatible. We've seen the incompatibility, and the problems with dropping either of the two standard constraints, within the best-worlds semantics.

If we keep the best-worlds semantics—or any of the standard deontic-modal style semantics—we're in a bind. With the belief set modal base constraint, the agent's beliefs are too influential: in Al's belief set, the concert-worlds are the drive-worlds, and so ordering sources (variable or not) can't distinguish the concert from the drive. Yet without the belief set modal base constraint, the agent's beliefs aren't influential enough: doxastic impossibilities are irrelevant to our desires. To make strongly conflicting desire ascriptions compatible without going wrong elsewhere, the agent's beliefs should influence the modal base some, but not too much. To properly capture the influence of the agent's beliefs on the modal base, I propose a new semantics.

6. A sketch of a coarse worlds semantics

Here's a hypothesis about *desire*—a hypothesis about how much our beliefs influence our desires—that makes strongly conflicting desire ascriptions compatible: in situations like Al's, the agent *considers* how the world will be in certain respects, but *ignores* how it will be in others.

Al can consider how things would be at the concert but ignore how they'd be during the drive. When Al considers *what the concert would be like*, what's good about the concert—he'd hear good music—comes to the fore. When Al ignores *what it would take to get to the concert*, what's bad about what it would take to get to the concert—he'd get carsick from the drive—does not come to the fore. In other words, when Al considers what the concert would be like, but ignores what it would take to get to the concert, *Al wants to go to the concert*. Similarly, when Al considers what the drive would be like, what's bad about the drive—carsickness—comes to the fore. When Al ignores what what he would do if he took the drive, what's good about what he would do if he took the drive—experience good music—does not come to the fore. In other words, when Al considers what the drive would be like, but ignores what he would do if he took the drive, Al doesn't want to take the drive.

This is a picture of *some-things-considered* (other-things-ignored) desire. Desire is not a *two-place* relation between an agent and a proposition, but rather a *three-place* relation between an agent, a proposition, and what the agent is considering. You don't desire *p simpliciter*. You desire *p* considering some things and ignoring others.

It will help to say a little more about considering. We'll model considering *p* with a *question* that bears on *p*. Formally, I'll take a question to be a partition on the total space of worlds, a partition whose cells are the exhaustive answers to the question (Hamblin, 1958):[18] e.g., the question *q?* is represented with $\{q, \neg q\}$.

> Say that a set of propositions Π *bears on a proposition p* iff *p* is entailed by some member of Π or $\neg p$ is entailed by some member of Π.

Take the question that asks both *does Al go to the concert?* and *does Al hear good music?* This question is $\{$*concert* $\wedge$ *good music*, *concert* $\wedge \neg$*good music*, $\neg$*concert* $\wedge$ *good music*, $\neg$*concert* $\wedge \neg$*good music*$\}$, and it bears on the proposition *Al goes to the concert*. We can use this question, call it 'Π_1', to represent considering going to the concert because its answers tell us about the concert, and in this case, also about not going to the concert. What about ignoring? To ignore something is to not consider it. We model ignoring *p* with a question that can't tell us about either *p* or $\neg p$—with a question that doesn't bear on *p*. So, for example, we can model ignoring the proposition *Al takes the drive* with Π_1 because Π_1 doesn't bear on *Al takes the drive*.

We're not interested merely in modeling Al considering what the concert would be like, but also in modeling what Al believes the concert would be like—after all, ways for the concert to be that Al believes are impossible are irrelevant to his desires. We need to fit the agent's beliefs in our picture of considering and ignoring. We need to model what the agent believes about a given question. An agent's beliefs about a given question eliminate answers to that question. Take again Π_1, and suppose that Al believes that he'll hear good music if and only if he goes to the concert. Al's beliefs are incompatible with certain answers to Π_1 (*concert* $\wedge \neg$*good music*, $\neg$*concert* $\wedge$*good music*), and compatible with others (*concert* $\wedge$ *good music*, $\neg$*concert* $\wedge \neg$*good music*).

Following Yalcin (2016), we'll call the set of answers to Π_1 that are compatible with Al's beliefs, Al's Π_1-*relative belief state*. More generally:

> A's *belief set* in *w* is the set of worlds compatible with what A believes in *w*.
>
> Where Π is a question, A's Π-*relative belief state* in *w* is the set of answers to Π compatible with what A believes in *w*: $\{p \in \Pi : p \cap \text{A's belief set in } w \neq \varnothing\}$.[19]

Yalcin has motivated the existence of question-relative belief states by arguing that they can help us solve certain problems that go under the name 'the problem of logical omniscience'.

[18] I don't think much turns on whether we use a partition approach to questions. I'm using it for concreteness.

[19] I'm defining question-relative belief states slightly differently from Yalcin, who thinks that agents' beliefs can't be represented with a belief *set*. This difference isn't important to my view.

Here, I'll take for granted that agents have question-relative belief states.

The answers to a question are propositions. To better understand my semantics, it will help to think of these propositions as *coarse worlds*. A coarse world is coarse in the sense that it does not decide the truth value of every proposition. Where defined, every proposition, or its negation, is *true* at a given (non-coarse) world. But not every proposition, or its negation, is *entailed* by a given coarse world.[20] I will use a bold '$\boldsymbol{p}$' to indicate that you should think of the proposition p as a coarse world.

Back to some-things-considered desire. The term 'considering' is a little misleading: it suggests something *episodic*. I don't mean it that way. In order for Al to want to see the concert—considering what the concert would be like, but ignoring what the drive would be like—there doesn't need to be, or have been, an *episode* of Al considering what the concert would be like. Compare: in order for Al to believe that he'd hear good music at the concert, there doesn't have to be, or have been, an episode of Al believing that he'd hear good music at the concert.

On the picture of some-things-considered desire, desire is a relation between an agent, a proposition, and what the agent is considering—more precisely, a relation between an agent, a proposition, and a question-relative belief state. Coarse worlds in questions decide the truth values of some propositions, but not others, and that's helpfully understood as the agent considering some propositions, but not others. I said, speaking loosely, that considering what the concert would be like, but ignoring what the drive would be like, Al wants to go to the concert. Strictly speaking, what I mean is that there is some question Π that bears on what the concert would be like, but not on what the drive would be like, and the desire relation holds between Al, the proposition *Al goes to the concert*, and Al's Π-relative belief state.

What is Π? The question-relative belief states that figure into our desire relations are complex. Whether Al desires to go to the concert depends on what he believes about a whole host of propositions: does Al hear good music? do The Who perform? which songs? does Al have fun? how much fun? how long is the concert? how loud? where does Al sit? will it be crowded? And so on. A question that bears on all of those propositions has a great many answers—many more than the four that e.g. Π_1 has. To make the semantics easier to understand, though, we'll consider how it works with toy questions. So in place of the true question that bears on all of these propositions about the concert, we'll use the question that asks just *does Al go to the concert?* and *does Al hear good music?* We'll use Π_1.

6.1. The semantics

The picture of some-things-considered desire adds an extra relatum to the desire relation—a question-relative belief state. To give a semantics that represents some-things-considered desire, we need to add an extra parameter—a question. Compare:

Old truth conditions, informally. ⌜A wants p⌝ is true iff p is *true* in all of the best

[20] 'Coarse worlds' comes from Yalcin (2011). See also Humberstone (1981).

(non-coarse) worlds in A's belief set, as ranked by A's total desire state.

New truth conditions, informally. ⌜A wants p⌝ is true with respect to Π iff p is *entailed* by all of the best coarse worlds in A's Π-relative belief state, as ranked by A's total desire state.

Two strongly conflicting desire ascriptions can both be true: each with respect to a different question.

Recall that Al's Π_1-relative belief state is $\{concert \wedge good\ music,\ \neg concert\ \wedge \neg good\ music\}$. There are two coarse worlds here: one where he goes to the concert and hears good music, and one where he doesn't go to the concert and doesn't hear good music. Hearing good music is better than not hearing good music, so he goes to the concert in the best coarse world in his Π_1-relative belief state. If Π_1 is available for evaluating (1), 'Al wants to see the concert', then (1) has a true reading.

We'll now use a second toy question, Π_2. Let Π_2 ask both *does Al take the drive?* and *does Al get carsick?*—i.e. $\Pi_2 = \{drive \wedge sick, drive \wedge \neg sick, \neg drive \wedge sick, \neg drive \wedge \neg sick\}$. Now suppose that Al believes that he'll get carsick if and only if he takes the drive: Al's Π_2-relative belief state is $\{drive \wedge sick, \neg drive \wedge \neg sick\}$. There are two coarse worlds here: one where he takes the drive and gets sick, and one where he doesn't take the drive and doesn't get sick. Not being sick is better than being sick, so he doesn't take the drive in the best coarse world in his Π_2-relative belief state. If Π_2 is available for evaluating (2), 'Al doesn't want to take the drive', then (2) has a true reading.

Let's state the semantics precisely. Before, the modal base was a function from an agent and world to a set of worlds. Now, it's a function from an agent, a question, and a world to a set of coarse worlds. The ordering source is still a function from worlds to sets of propositions (although the way that it orders possibilities differs slightly from before—see just below).[21]

$[\![\text{A wants p}]\!]^{w,f,g,\Pi} = 1$ iff $\forall \boldsymbol{q} \in \text{BEST}(\text{A}, w, f, g, \Pi)$: $\boldsymbol{q} \subseteq [\![\text{p}]\!]^{f,g,\Pi}$.

$[\![\text{A wants p}]\!]^{w,f,g,\Pi}$ is defined only if:

(i) *Constraint: unique (total desire) ordering source.* $g(\text{A}, w)$ represents A's total desire state in w.
(ii) *Constraint: question-relative belief state modal base.* $f(\text{A}, \Pi, w)$ = A's Π-relative belief state in w (when A believes neither p nor $\neg p$ in w).

These are not the only constraints we'll need (see below), but let's look at them first.

The question-relative belief state modal base constraint prevents the problem with the beyond-belief set modal base view. The problem was that the modal base contained worlds incompatible with the agent's beliefs—worlds irrelevant to the agent's desires. Tthe problem was that the agent's beliefs influenced the modal base too little. But if the modal base is the agent's question-

[21] Dandelet (ms) proposes a similar, situations-based semantics for 'want'.

relative belief state, then the modal base doesn't contain any *coarse worlds* incompatible with the agent's beliefs. The agent's beliefs *don't* influence the modal base too little.

The unique (total desire) ordering source is just what we had before. $g(\mathrm{A}, w)$ is the set of all propositions that A cares about. What's different is the way that the ordering source ranks possibilities. Before, the ordering source ranked (non-coarse) *worlds* on the basis of *which propositions those worlds make true*.

Old ordering: $u \preceq_{g(\mathrm{A},w)} v$ iff $\{p \in g(\mathrm{A},w) : v \in p\} \subseteq \{p \in g(\mathrm{A},w) : u \in p\}$.

Now, the ordering source ranks *coarse worlds* on the basis of *which propositions those coarse worlds entail.*[22]

New ordering: $\boldsymbol{q} \preceq_{g(\mathrm{A},w)} \boldsymbol{r}$ iff $\{p \in g(\mathrm{A},w) : \boldsymbol{r} \subseteq p\} \subseteq \{p \in g(\mathrm{A},w) : \boldsymbol{q} \subseteq p\}$.

We can now verify that (1) is true relative to Π_1. To simplify things, suppose Al just cares about hearing good music and avoiding sickness: $g(\mathrm{Al}, w)$ is $\{$*good music*, $\neg$*sick*$\}$.[23] Al's Π_1-relative belief state is $\{$*concert* $\wedge$ *good music*, $\neg$*concert* $\wedge$ $\neg$*good music*$\}$. There is a single concert-coarse-world in Al's Π_1-relative belief state, *concert* $\wedge$ *good music*, and it entails a proposition in $g(\mathrm{Al}, w)$, *good music*. But the no-concert-coarse-world in Al's Π_1-relative belief state, $\neg$*concert* $\wedge$ $\neg$*good music*, entails neither *good music* nor $\neg$*sick*, so the concert-coarse-world is ranked best within Al's Π_1-relative belief state: (1) is true relative to Π_1.[24] The explanation for why (2) is true relative to Π_2 goes along similar lines.

6.2. A comparison with the variable ordering source view

I propose:

Constraint: question-relative-belief-state-bearing-on-prejacent. $[\![\text{A wants p}]\!]^{w,f,g,\Pi}$ is defined only if A's Π-relative belief state in w bears on p.

This constraint prevents the immediate overgeneration problem that threatens the variable ordering source view. The variable ordering source view gives (1) a true reading with an available ordering source, g_1, which ranks concert-worlds best in Al's belief set. But given that in Al's belief set, the concert-worlds are the drive-worlds, g_1 ranks drive-worlds best: without further constraints on which ordering sources are available, the variable ordering source view incor-

[22]Two things to note. First, Cariani et al. (2013) have a related approach to 'ought'. Second, 'BEST' needs to be adjusted: $\mathrm{BEST}(\mathrm{A}, w, f, g, \Pi) = \{\boldsymbol{q} \in f(\mathrm{A}, \Pi, w) : \neg\exists \boldsymbol{r} \in f(\mathrm{A}, \Pi, w), \boldsymbol{r} \prec_{g(\mathrm{A},w)} \boldsymbol{q}\}$ (compare with footnote 8).

[23]Note that simplifying in this way wouldn't help the variable ordering source view. It faces overgeneration regardless of which propositions Al cares about.

[24]Note that the coarse world *concert* $\wedge$ *good music* contains (non-coarse) worlds where Al gets sick, as well as (non-coarse) worlds where he does not. The presence of (non-coarse) worlds where Al get sick doesn't matter to how *concert* $\wedge$ *good music* is ranked. The ordering source ranks coarse worlds *only* on the basis of which propositions those coarse world entail: since *concert* $\wedge$ *good music* contains both sick-worlds *and* no-sick-worlds, it does not entail that Al gets sick.

rectly predicts that (3), ‘Al wants to take the drive’, has a true reading.

My view gives (1) a true reading with an available question, Π_1, where concert-coarse-worlds are best within Al’s Π_1-relative belief state. Unlike g_1, Π_1 doesn’t give (3) a true reading: Al’s Π_1-relative belief state, $\{concert \wedge good\ music, \neg concert \wedge \neg good\ music\}$, does not bear on the prejacent of (3): neither member of this set entails either *Al takes the drive* or *Al doesn’t take the drive*. In other words, considering what the concert would be like, but ignoring the drive, it’s neither the case that Al wants to take the drive nor that he doesn’t want to take the drive: he is *ignoring* the drive. This is captured by the question-bears-on-the-prejacent constraint: (3) is *undefined* with respect to Π_1.

In §7, I say more about how my view compares to the variable ordering source view.

6.3. The agent’s beliefs don’t influence the modal base too *much*

We’ve seen that the agent’s beliefs don’t influence question-relative belief state modal bases too *little*. They also don’t influence question-relative belief state modal bases too *much*.

Al’s beliefs influence the belief *set* modal base too much because within Al’s belief set the concert-worlds are *coextensive* with the drive-worlds. We don’t have such coextension in question-relative belief state modal bases: the questions involved in question-relative belief states are partitions over the set of all worlds, partitions over the entire space of metaphysically possible worlds. (They are *not* partitions over the agent’s belief set.) Take Al’s Π_2-relative belief state, $\{drive \wedge sick, \neg drive \wedge \neg sick\}$. The drive-coarse-world here, $drive \wedge sick$, is coextensive with another coarse world just in case that coarse with is *metaphysically equivalent* to $drive \wedge sick$. But the proposition $drive \wedge sick$ is not metaphysically equivalent to any coarse world where Al goes to the concert (i.e. it’s not metaphysically equivalent to any proposition that entails that Al goes to the concert).

The key here is that considering merely whether he’ll take the drive and whether he’ll get sick, and ignoring the concert, Al ignores the relationship between the drive and the concert. Even though Al believes that he’ll see the concert if and only if he takes the drive, that belief makes no difference to which coarse worlds are in his Π_2-relative belief state. Al’s Π_2-relative belief state is the set of coarse worlds in Π_2, $\{drive \wedge sick, drive \wedge \neg sick, \neg drive \wedge sick, \neg drive \wedge \neg sick\}$, that are compatible with his beliefs. Only certain of Al’s beliefs make a difference to which of these coarse worlds are compatible with his beliefs. Although Al believes the proposition *concert iff drive*, that proposition is *compatible* with every coarse world in Π_2, so his belief in *concert iff drive*, doesn’t affect which coarse worlds are in his Π_2-relative belief state. Some of the agent’s beliefs influence the modal base—a belief influences the modal base if it’s incompatible with an answer to the relevant question. But not all of an agent’s beliefs are incompatible with answers to a given question, so not all of the agent’s beliefs influence the modal base. The agent’s beliefs influence the modal base some, but not too much.

7. Conclusion

The standard semantics, given two standard constraints, make strongly conflicting desire ascriptions incompatible. There are two proposed solutions—the variable ordering source view, and the beyond-belief set modal base view—each of which drops one of constraints. I've argued that the beyond-belief set modal base view is misguided: possibilities incompatible with an agent's beliefs are irrelevant to what she desires. I have not taken such a strong stance against the variable ordering source view. I pointed out that as long as we keep the belief set modal base in a non-coarse worlds framework, ordering sources can't distinguish propositions that must be distinguished, which means that the variable ordering source view overgenerates *without further constraints* on which ordering sources are available. No further constraints have been given. That doesn't mean they couldn't be given in a principled way, although I'm pessimistic.

I've sketched my own way to make strongly conflicting desire ascriptions compatible: a coarse-worlds semantics based on a picture of some-things-considered desire. My view has two principal merits. First, the picture of some-things-considered desire gives an intuitive explanation of why our *desires* strongly conflict, a picture that my formalism captures. Second, what we learned by looking at the two proposed solutions was that the problem with strongly conflicting desire ascriptions stems from the extent to which our beliefs influence our desires. A solution to the problem needs belief to influence desire some, but not too much, and mine does.

A *complete* solution to the problem will allow us not just to say that some, but not all, beliefs influence desire. It will also identify, in a principled way, *which* beliefs influence which desires. I have already done some identifying (e.g. Al's desire to go to the concert is influenced by his beliefs about what the concert would be like, but not by his beliefs about what the drive would be like). Nonetheless, I have only given a sketch of my semantics—not a complete solution. I have not given a complete, principled answer to the question *which questions are available for evaluating a given desire ascription?* To properly answer that question I need further constraints—beyond those I have given—on which questions are available. Without such constraints, my account will overgenerate. This means that I have not shown that my view has a decisive advantage over the variable ordering source view. But I hope to have shown that the some-things-considered desire framework—and so the coarse-worlds framework—is a powerful one for identifying which beliefs influence which desires. Developing further constraints within this framework is the most important task for future work.

Here are two other issues that I hope to pursue in future work.

First, any adequate account of 'want' needs to address certain invalid inferences that Villalta noted.[25] She pointed out that Heim's semantics wrongly validates inferences like:

(8) a. Cy wants to pass.
  b. Cy believes that he'll pass if and only if he studies.
  c. So, Cy wants to study.

[25] Pettit (1991) noted similar inferences.

It's not just Heim's semantics that validates such inferences. Any semantics that uses (an analog of) the belief set modal base constraint wrongly predicts that 'want' is *closed under believed extension*. On my view, both (8a) and (8b) can be true in a given context *c*, while (8c) is not true but *undefined* with respect to the question that *c* determines. The further constraints I just mentioned are constraints on definedness conditions: understanding what these constraints are can shed light on why closure inferences fail.[26]

Second, although I've shown my idea for a coarse worlds semantics within the best-worlds framework, the best-worlds framework is not essential. I've used it not because I think it is the right framework for 'want'—it has its limitations—but because the Kratzer-style ranking on (non-coarse) worlds extends transparently to a ranking on coarse worlds (the ordering source ranks (non-coarse) worlds on the basis of the propositions those (non-coarse) worlds make true, and it ranks coarse worlds on the basis of the propositions those coarse worlds entail). Coarse worlds can be implemented within other semantics, too. Within a given semantics, we replace (non-coarse) worlds with coarse worlds and adjust accordingly. The implementations will be different within different semantics. (For example, some semantics use a probability distribution over worlds, and that distribution will have to be extended to coarse worlds.) The point is that a coarse worlds semantics—within the best-worlds framework or not—is a promising approach to strongly conflicting desire ascriptions.

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[26] Two things to note. First, my view does make closure inferences *Strawson-valid* (von Fintel, 1999, 2001). Understanding what Strawson validity has to do our intuitions of validity in these cases is another thing to explore further. Second, Crnič (2011) also suggests that something like question-relative belief states can help with these inferences, although he doesn't develop his suggestion or discuss constraints on which questions are available.

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Paradigm-induced implicatures of TAM markers: The case of the Daakaka distal[1]

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Abstract. The distal TAM-marker in the Oceanic language Daakaka (Vanuatu) refers to events in the actual past as well as the counterfactual past, present and future. It comes with a cessation interpretation similar to English simple past statives and similar to markers of (discontinuous) past in other languages. For English and Tlingit, it has been argued that this cessation interpretation is a pragmatic implicature rather than part of the lexical semantics. I will argue that in Daakaka, too, the cessation interpretation is the result of an implicature, but that this can only be understood if the modal dimensions of the TAM markers are taken into consideration.

Keywords: Oceanic, TAM, tense, modality, implicatures, cessation, discontinuity

1. Introduction

Discontinuous past markers have been described for a wide variety of languages from diverse families and areas. Plungian and van der Auwera (2006: 317) therefore suggest that "[d]iscontinuous past can thus be analyzed as a special cross-linguistically valid type of past tense marking." Plungian and van der Auwera (2006) assume that the discontinuity interpretation can be a lexical feature of past markers and that discontinuous past is therefore a distinct category from regular past.

However, Cable (2017) suggests that the discontinuity interpretation of past markers in some languages is not a built-in part of their lexical semantics, but rather the result of pragmatic reasoning, similar to Altshuler and Schwarzschild (2012)'s analysis of cessation implicatures in English simple past.

The Daakaka distal adds an interesting complication to this picture. Although its discontinuity interpretation can also be shown to be context-dependent and thus non-lexical, it defies the typological generalizations by Cable (2017), who suggests that discontinuous past markers occur exclusively in languages with optional tense marking.[2]

In Daakaka, however, TAM marking of finite clauses is obligatory. While we will see that this observation itself is not a great obstacle to applying Cable (2017)'s analysis, I will discuss several aspects of his theoretical approach that are problematic and at odds with established assumptions.

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[2]Note that this is not fully supported by Plungian and van der Auwera (2006). They cite Washo and systems with a binary remoteness distinction or a pluperfect as possible counterexamples.

I will argue that the discontinuity implicature of the Daakaka distal can only be understood if we consider its modal as well as its temporal meaning.

2. Background

Daakaka is an Oceanic language of Vanuatu, spoken by about one thousand people on the island of Ambrym and the small diaspora in Vanuatu's cities Port Vila and Luganville. Its basic word order is SVO and it has a fairly strictly developed system of lexical classes (von Prince, 2015). All data come from my own fieldwork. The bulk of the data comes from the corpus I created during a language documentation project between 2009 and 2012. Referenced examples refer back to the corpus, which is published in The Language Archives (TLA) and which I constantly work on to make it more consistent and more accessible.

3. TAM markers in Daakaka

Finite clauses in Daakaka have to contain a TAM marker. They typically cliticize to the preceding subject agreement marker or to the subsequent verb. With third-person singular subjects and non-human subjects, there is no subject agreement marker and the TAM marker will be realized as a monosyllabic word with a vowel determined by the subsequent verb instead. The following two examples show the realis marker:

(1) *waawu,* *na=**m*** *pyane swa kemyas kyun.*
grandparent 1SG=REAL roast one only just
"grandmother, I have only roasted one."[3] (5401)

(2) *ulilir* ***mu*** *du-ru* *yen bwili wye*
prawn REAL REDUP-stay in hole.of water
"Prawns live in fresh water ponds" (1775)

The TAM markers form a rather close-knit unit with the subject-agreement marker and the verb. The only thing that can interfere between them are auxiliaries and some aspectual particles. The main temporal-modal contrasts of the system are instantiated by the markers in table 1.

In addition, there are two other markers, which play a less important role in the context of this article:

- *too* is used exclusively for embedded polarity questions about the episodic past or present as in *I don't know whether she has arrived already*.

[3] ATT – attributive linker; COMP – complementizer ; CONT – continuous aspect; COP – copula; COS – change of state; DEF – definite; DEM – demonstrative; DISC – discourse marker; DIST – distal TAM; EX – exclusive; IMPF – imperfective; IN – inclusive; LOC – locative; MED – medial; MOD – assertion marker; POSS – possessive; POT – potential ; PROX – proximate; REAL – realis; REDUP – reduplication ; RES – resultative suffix ; TOP – topic marker; TRANS – transitivizer.

	enclitic	proclitic	monosyllabic
Positive Realis	*=m*	*mw=*	*mwe/mV*
Negative Realis			*to*
Positive Potential	*=p*	*w=*	*wV*
Negative Potential	*=n*		*nV*
Distal	*=t*	*t=*	*tV*

Table 1: The main TAMP markers of Daakaka (cf. von Prince, 2015)

- *bwet* has the same temporal-modal implications as the realis marker, with the additional information that an event constitutes a new development.

The positive realis marker is by far the most frequent in my corpus. It is used to talk about the contextually determined actual past and present. In fictional settings, where the actual present is shifted to a fictional world, the realis marker is also used throughout. The potential markers are used to talk about future developments relative to the matrix clause or relative to the utterance context; they can also refer to epistemic possibilities of the present (but not the past). In the following discussion, we will contrast the distal marker with the realis marker in particular. First, however, let us have a closer look at the distal and its various functions.

4. The distal TAM marker

4.1. Discontinuous past

As we have seen in the previous section, TAM markers in Daakaka are obligatory in finite sentences. In this section, we will explore the distal marker in more detail and see how it corresponds to the category of a discontinuous past marker as observed by Plungian and van der Auwera (2006) and Cable (2017).

Plungian and van der Auwera (2006) suggest the following typical properties for discontinuous past markers.

(3) a. They are idle past markers: In the majority of event descriptions of the past, they are *not* used.
b. They are mostly used with imperfective predicates, in which case they denote states that do not extend to the present moment.
c. When they occur with perfective event descriptions, they express that the result of an action does not hold at the time of speaking.

I will show now that all these criteria apply to Daakaka. I will start with the observation that the realis is the standard marker to refer to past events. In my corpus, there are over 8400 matches for the realis marker as opposed to just over one thousand occurrences of the distal. And only in a minority of those cases where the distal marker is used does it clearly express a discontinuous past. Most of the texts in the corpus are narratives about the actual or fictional past, and in both cases, the realis marker is the most frequent form throughout. The following beginning of a story illustrates this:

(4) *bili na sa wotop* ***mwe*** *pa,*
time COMP TOP breadfruit REAL bear.fruit
"when the breadfruit tree bore fruit," (5443)

(5) *te gee* ***ma*** *ka t-en sivi ye=∅ vyan te vyan du ane wotop*
DISC flying.fox REAL say and-3S.POSS lorikeet 3D=POT go DISC go stay eat breadfruit
"the flying fox suggested to the lorikeet that they go to eat breadfruit" (5444)

(6) *ye=****m*** *vyan* ***ma*** *ge=tak, du en-en vyan te*
3D=REAL go REAL be.like=PROX stay REDUP-eat go DISC
"they went like that and they were eating, when. . . " (5445)

Having established that the default marker for the actual past is the realis marker, I will now turn to the distal marker in unembedded environments where it refers to events or states of the actual past. These cases almost always involve a discontinuity interpretation.

In accordance with (3b), most of those cases involve stative predicates and then induce the interpretation that something used to be the case but is no longer the case. A typical example is given in (7), where the stative predicate is *dyanga* (not exist). The speaker talks about the millipede being an alien species which only arrived on Ambrym recently.

(7) *dereli, nge* ***te*** *dyanga teve nyem, nge bwet dakap me kyun*
millipede 3S DIST lack side.of 1PL.EX 3S COS recently come just
"the millipede didn't use to be with us [here], it just came recently" (2203)

Another example illustrates the use of the distal with the imperfective auxiliary *du* to talk about the habitual, discontinuous past.

(8) *te t=i seli swa na yap myató nyoo* ***ya=t du*** *gene meerin*
DISC DIST=COP road one COMP old.man old 3P 3P=DIST IMPF make long.time
"[spear throwing] was a tradition the old ones used to perform long ago" (5201)

As required by generalization (3c), the distal marker can also function as a discontinuous past marker in the context of perfective event descriptions; as expected, it then usually expresses that the result of an action does not hold at the speech time. The following example is from a story about a group of people who want to cultivate a new patch of bush for food crops. But a mischievous *lisepsep* (a dwarf-like creature with magical powers) makes the trees grow back as they were before. When they come back to visit the next day, one person expresses their astonishment that the tree they had cut down is whole again: The result of the cutting no longer holds.

(9) *swa mwe ka, nye nenyu* ***na=t*** *me te te lee en=tak*
one REAL say 1S yesterday 1S=DIST come DISC cut tree DEF=PROX
"one said: 'I cut this tree yesterday' (lit.'I had come and cut this tree')" (3074)

In addition to the properties by Plungian and van der Auwera (2006), Cable (2017) adds suggests the following generalization:

> [...] there does not appear to be any language with an obligatory discontinuous past marker; that is, in every language with a putative "discontinuous past", the marker in question does not have to be used in contexts supporting a cessation inference.

This, too, is the case in Daakaka. Thus the following two sentences come from two different versions of the same story, recorded at different occasions. They are almost identical, except for two things:

1. The main TAM marker in (10) is a realis marker, as opposed to the distal marker in (11).
2. The sentence with the realis marker in (10) contains the temporal adverbial *meerin* "a long time ago".

(10) ***meerin*** *nya ye* ***mw=i*** *bivian na* ***mu*** *vu ten*
long.time 3D 3D REAL=COP friend COMP REAL good very
" before, [the rat and the cat] used to be good friends" (0912)

(11) *pus myane tomo, nya ye* ***t=i*** *bivian* ***tu*** *vu ten*
cat with rat 3D 3D DIST=COP friend DIST good very
"the cat and the rat, they used to be very good friends" (4597)

This shows that distant and discontinuous past can be referred to by the realis marker as well as the distal. Without further specification however, the default interpretation of the realis marker is a reference to the utterance time or the topic time (which are identical at the very beginning of a story). An expression like *meerin* ("a long time ago") can help to get the intended, non-default reference to the past.

In sum, this section has shown that the Daakaka distal marker can clearly be identified as a discontinuous past marker by the criteria brought forward in the literature.

4.2. Other functions of the distal

Other than marking the discontinuous actual past, the distal is also instrumental for talking about counterfactuality. It is the only marker in the language that can be used in the context of counterfactual developments in the past or present. This reference is available in matrix clauses, if the context makes a counterfactual interpretation plausible:

(12) *Nye na bwe dimyane ka ebya-ok we pwer kyun, [na=****t*** *ka pini or.]*
1SG 1SG CONT want MOD wing-3S.POSS POT stay just 1SG=DIST fly fill place
"I wish I had wings, I would fly around everywhere."

Counterfactual interpretations can of course also be found in conditionals:

(13) *[tati, saka w=i vyaven en=tak te] [saka* ***ko=t*** *esi*
dad MOD.NEG POT=COP woman DEM=PROX Glossdisc MOD.NEG 2SG=DIST see
nye]
1SG
"father, if it had not been for this woman, then you would never have seen me again" (4856)

Complement clauses of verbs of thinking, wishing and saying can also be headed by the distal to signal that the prejacent is not asserted by the speaker:

(14) *te ma* ***ka ti*** *mini sye swa yen kava*
DISC REAL say DIST drink something one in kava
"and he (wrongfully) said he had drunk something in the kava."

In sum, we have seen that, outside of the protasis of temporal and conditional clauses, the distal marker can refer to the discontinuous actual past, or to the counterfactual past, present or future. Within the protasis of temporal and conditional clauses, it may also refer to the future. However, by far the most frequent environment for the distal to occur is the protasis of temporal and conditional clauses. In (15), the distal expresses a reference to the episodic past:

(15) *[or ka* ***te*** *myaek] te mwe me vyan te syu ane apyaló-ten*
place MOD DIST be.night DISC REAL come go DISC land TRANS ship-native
"at night, he went and sat down in the canoe" (4723)

Within this environment, its interpretation and distribution crucially differs from matrix clauses in several respects:

1. It occurs with non-stative predicates as the norm, not as the exception.
2. There is no discontinuity effect.
3. It does not necessarily refer to past events. It can also refer to the generic present and to the future.

Of course, point 2 is also crucial for the hypothesis that the discontinuity reading is not part of the lexical definition of the distal marker, but comes in as an implicature. In the following example, the distal marker does not refer to the past at all, but rather to the generic present. Accordingly, there is no discontinuity reading here. Someone could have an appetite for eating doves right now, nothing to the contrary is implicated by this sentence.

(16) *[ka vyanten* ***te*** *dimyane ka wa ane maa] te mwe gene kuo*
COMP person DIST want MOD POT eat dove DISC REAL make trap
"When someone wants to eat dove, they make a trap" (0523)

The example in (17) illustrates a reference to the episodic future. It is uttered by a small bird in a story where this bird wants to steal breadfruits from the magical creature known as *lisepsep*.

(17) *[ka lisepsep **te** me], te nye ka na=p ka*
COMP lisepsep DIST come DISC 1S MOD 1S=POT fly
"if the lisepsep comes, then I will fly away." (4496)

This kind of temporal reference is only ever available for the distal in the protasis of temporal and conditional clauses. It is not only absent in matrix clauses, but also from complement clauses, relative clauses and adverbial clauses. Usually, temporal and conditional clauses are introduced by the complementizer *ka*, but even if *ka* is not there, clauses headed by the distal can often only be interpreted as temporal or conditional:

(18) *[**ki=t** me a=tak] ka na w=ane kimim*
2P=DIST come LOC.DEM=PROX MOD 1S POT=eat 2P
"if you come here, then I will eat you!" (3133)

(19) *[**ko=t** kii-kuwu] te mu kuo*
2S=DIST dig-RES.out DISC REAL run
"when you dig it out, it runs away" (6104)

For reasons of space, I cannot give a full account of why these temporal references become available for the distal exclusively in these environments. I will argue below that they are covered by the lexical definition of the distal, but typically blocked by pragmatic defaults and via its contrast to the realis and potential markers. In this particular context, however, this contrast is partially removed because the realis marker in particular is not allowed in this environment.

Concluding this section, we have seen that the functions of the distal marker go far beyond a reference to the discontinuous past. In the right context, it can also refer to counterfactual scenarios. And in the protasis of temporal and conditional clauses, a reference to the future and present also becomes available.

5. Previous approaches to discontinuity interpretations

5.1. Altshuler and Schwarzschild (2012)

Altshuler and Schwarzschild (2012) discuss the cessation implicature of English simple past with stative predicates. For example, in the given context in (20), B's utterance implicates that Scotty is no longer anxious:

(20) A: How is Scotty doing?
B: He was anxious.

Their analysis relies on two assumptions: One about the semantics of stative predicates, and one about the contrast of English simple past to English simple present. I will argue in this section that the cessation implicature for the distal cannot be derived in the same way that Altshuler and Schwarzschild (2012) propose for English simple past. One important empirical difference that already foreshadows this conclusion is that the discontinuity reading for the Daakaka distal also applies to non-stative predicates, in contrast to English simple past. The theoretical reasons for this difference are however interesting enough to deserve some exploration. Let us first briefly review the proposal by Altshuler and Schwarzschild (2012). One fundamental assumption is that stative sentences have the following temporal profile:

(21) Temporal Profile of Statives:
For any tenseless stative clause ϕ, if ϕ is true at moment m, then there is a moment m' preceding m at which ϕ is true and there is a moment m' [sic] following m at which ϕ is true.

The notions of simple past and simple present could then be formalized as follows:[4]

(22) English simple present, as applying to statives:
$[\![\textsc{Pres}]\!] = \lambda w_0 \lambda t_0 \lambda p. \exists t. t = t_0, p(t)(w_0)$

(23) English simple past, as applying to statives:
$[\![\textsc{Past}]\!] = \lambda w_0 \lambda t_0 \lambda p. \exists t. t < t_0, p(t)(w_0)$

It follows from these assumptions that a stative clause in the present tense logically implies the corresponding sentence in the past tense, but not vice versa.

(24) a. *Scotty is anxious* implies
b. *Scotty was anxious*

(25) $[\![(24a)]\!] = \exists t. t = t_0, \textbf{anxious}(\textbf{scotty})(t)(w_0)$, assuming (21)
$\vdash \exists t \exists t'. t = t_0, t' < t, \textbf{anxious}(\textbf{scotty})(t)(w_0), \textbf{anxious}(\textbf{scotty})(t')(w_0)$
$\vdash \exists t. t < t_0, \textbf{anxious}(\textbf{scotty})(t)(w_0) = [\![(24b)]\!]$

This means that simple present and simple past in English are scalar alternatives. When an utterance is part of a set of scalar alternatives, it implicates the negation of its stronger alternatives. In the case of English tenses, the use of the simple past in a stative description can therefore give rise to the implicature that the prejacent is not true in the present. This same mechanism would not translate straightforwardly to the Daakaka data though, because of the difference between the Daakaka realis and the English present tense. If we only look at the purely temporal usage of the distal and realis markers for the moment, without considering counterfactuals and other modal environments, we might conclude that they only differ from English past and present in that the realis marker also applies to past events in addition to present ones. This idea is spelled out below:

[4]Here, I am glossing over the reference time concept, which ensures that the cessation implicature does not arise in contexts that are explicitly about the past as in the following context:

(i) a. There was a book on the table.
b. It was in Russian.

I am also glossing over the authors' assumption that tenseless clauses can be true at intervals, which would be compatible with the following slightly different formalization:

(ii) $[\![\textsc{Pres}]\!] = \lambda w_0 \lambda t_0 \lambda p \lambda I. \exists t. t = t_0, p(I)(w_0), t \in I$

(26) Daakaka distal (first suggestion, to be rejected):
$[\![\text{DIST}]\!] = \lambda w_0 \lambda t_0 \lambda p.\exists t.t < t_0, p(t)(w_0)$

(27) Daakaka realis (first suggestion, to be modified):
$[\![\text{REAL}]\!] = \lambda w_0 \lambda t_0 \lambda p.\exists t.t \leq t_0, p(t)(w_0)$

Let us assume for a moment that these definitions were correct. Then, the distal and the realis would in fact form a scale, since the distal would imply the realis. But this means that the distal would be the stronger expression, the realis marker would be weaker. Therefore, using the distal would not generate an implicature via its contrast to the realis marker. So the above picture cannot be entirely correct. Furthermore, we have seen that the realis marker can refer to the actual past and present and essentially nothing else. Therefore, the definition in (27) cannot be too far off the mark. We will have to reconsider the definition of the distal marker instead.

We will see later on that the definition of the distal marker has to be extended to include also counterfactual developments. However, we cannot extend it to include the actual present. If we did, the realis marker would end up as the stronger alternative to the distal. But then we would no longer get a temporal contrast between the two and would no longer expect the distal to refer to the actual world at all. Therefore, the cessation implicature cannot be derived purely from a scalar contrast. The same problem is faced by Cable (2017), which is the second approach we are going to review.

5.2. Cable (2017)

At first glance, the approach by Cable (2017) does not appear to work for Daakaka because it is based on the assumption that the discontinuity interpretation is a consequence of the optionality of tense marking. Quoting from the abstract of Cable (2017):

> I develop an account of the cessation inference in Tlingit, whereby it arises from the optionality of the past-tense marker in question. I argue that this account should be extended to all putative instances of "Discontinuous Past", since it would capture the fact that putative cases of "Discontinuous Past" only ever arise in optional tense languages.

Daakaka is a straightforward counterexample to the above generalizations. The Daakaka TAM markers have modal and, to a lesser extent, aspectual implications as well as temporal ones. In that sense, it could be argued that they are not tense markers at all. However, the same goes for most markers that have been labeled as tense markers; thus, indicative tense forms in European languages have usually different modal implications from subjunctive ones. And markers from other languages that appear to have essentially the same modal-temporal interpretations as the realis marker have been labeled as non-future tense markers.

In short, Daakaka is a language that requires any finite clause to be marked by a morpheme from a small paradigm of TAM markers. And the meanings of these markers have temporal implications as well as modal and, to a lesser extent, aspectual ones. Daakaka can therefore be said to have obligatory tense marking. It is definitely not an optional-tense language in the sense intended by Cable (2017).

However, a closer look reveals that Cable (2017) is still potentially relevant for the puzzle at hand. In fact, what is crucial for Cable (2017)'s analysis is not the optionality of tense marking, but the presence of a non-future tense that contrasts with the marker expressing discontinuous past. And the Daakaka realis marker may well be described as a marker of non-future tense – with the additional modal restriction to actual developments. It turns out that the facts reported by Cable (2017) for Tlingit appear very similar to Daakaka. There are two theoretical reasons why I will still not adopt Cable (2017)'s analysis here:

1. One of the pragmatic principles he assumes appear to directly contradict Gricean reasoning. As a result, the analysis predicts that speakers should choose the weakest possible tense marker, contradicting standard pragmatic reasoning according to which weaker expressions are blocked by their stronger alternatives.
2. If we adopt only the definitions for the distal and the realis (non-future) without the above pragmatic principles, we would predict that the realis, as the weaker alternative, should not be used whenever the distal can felicitously be used instead. This is however not the case.

Let us start with the second point, since it also directly builds on the observations we have made in the previous section. There, we have reviewed the following assumptions:

1. The realis marker refers to actual events of the past or present.
2. The distal marker refers to actual events of the past.

I have already foreshadowed that my analysis will abandon the second of these assumptions. If these assumptions were true, then the distal and the realis would be scalar alternatives, with the distal being the stronger alternative of the two. I have argued above that this setup cannot provide us with an explanation for the discontinuity reading in the style of Altshuler and Schwarzschild (2012), because the elements in this scale are in the wrong order: Altshuler and Schwarzschild (2012) can derive their cessation implicature because the present (in combination with statives) is the stronger element; but in our case, the past, or distal, is stronger.

Not only would this situation under standard pragmatic assumptions fail to get us the desired discontinuity implicature, however. It would also make false predictions. Thus, since you should always choose the strongest assertable candidate of a scale, it should be infelicitous to use the realis marker in a situation where the distal marker could also have been used. But we have seen that this happens without any restrictions. The relevant example pair is repeated below, showing the realis in a context that clearly supports a discontinuity inference:

(10) ***meerin*** *nya ye* ***mw=i*** *bivian na* ***mu*** *vu ten*
long.time 3D 3D REAL=COP friend COMP REAL good very
" before, [the rat and the cat] used to be good friends" (0912)

(11) *pus myane tomo, nya ye* ***t=i*** *bivian* ***tu*** *vu ten*
cat with rat 3D 3D DIST=COP friend DIST good very
"the cat and the rat, they used to be very good friends" (4597)

Furthermore, if the realis and the distal were true scalar alternatives, using the realis should in fact implicate the negation of the (stronger) utterance with the distal. In other words, the use of the realis should then have the implicature that something is the case in the present, but was not the case in the past. But this effect cannot be observed, as also illustrated by (10). The situation in Tlingit is virtually identical with respect to the considerations at hand, and yet Cable (2017) proposes that the discontinuity interpretation of the Tlingit past still pragmatically derives from its contrast to non-future tense. The key element in this proposal is the following pragmatic principle for production:

(28) (Cable, 2017: (36)): Make the topic time as large as possible.

According to this principle, if you can possibly use an expression that covers both the speech time and a time prior to that, you should always do that. This would of course directly reverse the pragmatic defaults worked out so far. It would also seem to contradict the Gricean principle of Quantity, which has previously been assumed to operate also on the interpretation of tenses (Smith et al., 2007; Mucha, 2015).

It will remain to be seen which pragmatic principles guide the choice and interpretation of TAM markers cross-linguistically, and this is still a very new field with much left to discover. But this initial assessment should at least have convinced us that there is room for doubt when it comes to Cable (2017)'s assumption in (28). And that looking for an alternative approach may be worthwhile.

In sum, we have seen that a simple, elegant solution that merely appeals to scalar alternatives along the lines of Altshuler and Schwarzschild (2012) is not feasible for the Daakaka system. The same problem is faced by Cable (2017), who introduces a somewhat counterintuitive pragmatic principle to solve it. In the following section, I will propose an alternative route, which harnesses the power of established pragmatic principles by looking beyond the merely temporal meanings of the distal and taking into account its modal implications.

6. The modal dimension

6.1. Fundamental observations and assumptions

If we only take into account the purely temporal reference of the distal and realis markers, the distal would appear to have the narrower definition and be the stronger of two scalar alternatives. Given that, it would seem puzzling that its use has any implicatures at all. In this section, I will argue that the distal in fact has a much wider reference than the realis and they are not scalar alternatives. This becomes clear when we also take into account the modal dimension.

We have seen in section 4.2 that the distal not only refers to the discontinuous actual past. It is also the only option in the language to talk about counterfactual scenarios in the past and present. And in the context of conditional and temporal clauses, it can also refer to future eventualities. The counterfactual use of the distal in particular is fairly typical cross-linguistically for markers of discontinuous past. As Plungian and van der Auwera (2006) write:

> The use of the discontinuous past markers within hypothetical or counterfactual conditionals (the boundary between them is not always very neat, cf. Comrie 1986 and Athanasiadou and Dirven 1997 for more detail) is widely attested, including, as far as we can judge, almost all Creole and West African systems, witness Wolof (30a).

The relation between the past and the counterfactual has been observed early and explored by many, prominently including Fleischman (1989); Iatridou (2000), to name just two. I will here propose a new approach to this relation, whose implications go far beyond the scope of this paper. While I will not be able to explore all its logical constraints and consequences in this context, it will suffice to define and model the meaning of the distal including both its temporal and its modal dimensions and thus allow us to move forward with the analysis of the discontinuity interpretation.

The main ingredient for my analysis is the branching-times structure that is a very well-established tool for exploring the relation between time/tense and modality (e.g. Dowty, 1977; Thomason, 1984; Condoravdi, 2002; Laca, 2012; Ippolito, 2013).

My basic definition of the branching structure follows Thomason (1984):

(29) Definition Branching Times: A branching-times frame $\mathfrak{A}$ is a pair $\langle I, < \rangle$, where
  a. I is a non-empty set of indices i; $<$ is an ordering on I such that if $i_1 < i$ and $i_2 < i$, then either $i_1 = i_2$, or $i_1 < i_2$, or $i_2 < i_1$.
  b. A **branch** through i is a maximal linearly ordered subset of I containing i.
  c. An index i_1 is called a **predecessor** of i_2 iff $i_1 < i_2$; it is a **successor** of i_2 iff $i_2 < i_1$

I propose here a major theoretical innovation to this approach. Thomason (1984) and everyone else working with branching times, to the best of my knowledge, has only ever considered the definition in (29) as a way to define historical accessibility. This is why quantification over branching times has always been restricted to those branches that are identical up to the actual present. Thus, in the toy model represented in the following figure, if i_2 is the actual present, then quantification is restricted to branches b_3, b_4.

It is also possible to quantify over all six branches $b_1, \ldots b_6$, if one shifts the perspective backwards to i_1. However, it is not possible to quantify exclusively over b_1, b_2, b_5, b_6, because from i_2 they are not accessible at all, and from the perspective of i_1 the precedence relation cannot distinguish them from b_3 and b_4. The decision to restrict quantification in this way was originally well motivated, since the model was designed to define historical accessibility. However, I propose to not treat the branching structure itself as an accessibility relation but as an ordering relation on the set of indices that allows for the definition of various temporal-modal domains.

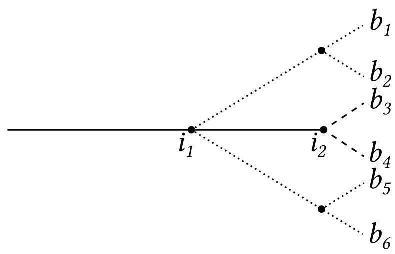

Figure 1: A branching-times structure. Relative to i_2, the solid line represents the actual past, the dashed lines the possible futures and the dotted lines counterfactual developments.

The precedence relation generates the following three-way distinction between modal-temporal domains relative to the contextually defined actual present i_c:

(30) a. the actual (past or present): $\{i|i \leq i_c\}$
b. the counterfactual (past, present or future): $\{i|i \nleq i_c, i_c \nless i\}$
c. the possible (future): $\{i|i_c < i\}$

6.2. Definitions and derivation

I propose that natural language expressions can refer to any of the three domains in (30) to the exclusion of the others, as well as to subsets and combinations of them. We have seen that the distal can refer to all temporal-modal domains except for the actual present. The following definition captures this observation:[5]

(31) $[\![\text{DIST}]\!]^{g,c} = \lambda i : i \neq i_c.i$, where i_c is the contextually defined actual present (by default the index of utterance).

We can now also take the definition of the realis in (27) and re-cast it in the newly developed terms:[6]

(32) $[\![\text{REAL}]\!]^{g,c} = \lambda i : i \leq i_c.i$

These definitions are illustrated in figure 2.

The definition of the distal is strongly reminiscent of Iatridou (2000)'s Exclusion Feature for English simple past. At the same time, its grounding in a branching-times structure makes it directly comparable to the realis marker. We can now see that the distal marker and the realis marker are not really scalar alternatives at all. Their meanings overlap, but neither fully

[5]I adopt the standard assumption that tense expressions place presuppositional restrictions on pronominal tenses, though nothing hinges on this decision at this point. I recommend Bochnak (2016) for a concise and recent overview.

[6]Also compare with the proposal by Krifka (2016) for the very similar realis marker in the neighbouring language Daakie.

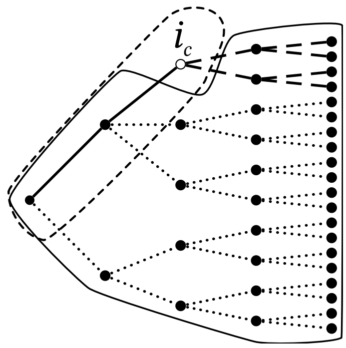

Figure 2: The temporal modal domains of the realis marker (dashed outline) and the distal marker (solid outline).

includes the other. At the same time, we can see that the definition of the distal is much less restrictive. The distal marker is less informative than the realis marker. This is well in line with the observation that the default way to talk about the actual past is to use the realis marker, not the distal. Linking back to the previous discussion, we can still not operationalize a scalar contrast between the realis and the distal as in Altshuler and Schwarzschild (2012). But in contrast to Cable (2017) we can now see that the past (distal) marker is the less informative of the two and I suggest that we can get some leverage out of this difference for deriving the discontinuity interpretation.

To account for the interpretation of the distal, we will need to appeal both to an interpretation principle and to a production principle, just as Altshuler and Schwarzschild (2012) and Cable (2017) do. Altshuler and Schwarzschild (2012) could simply appeal to the Gricean maxim of Quantity. Cable (2017) posited the production principle cited in (28) to reverse the effects of the maxim of Quantity. With the definitions in (31) and (32), we can once again appeal to Quantity as the driving force behind the discontinuity interpretation. Even though the realis and the distal are not scalar alternatives, one is clearly more restrictive than the other. This difference in restrictiveness can be understood in at least two ways – in terms of the domains referred to and in terms of quantities of indices. Out of the three different domains identified in (30), the realis only includes one, while the distal cuts across all three. Quantities of indices are not trivially measured since I understand the branching-times structure as a concept the scope and granularity of which change dynamically and which contains potentially infinite numbers of indices. But to compare the distal with the realis, consider that in the domain of actual indices, the distal contains only a single index less than the realis. So in any situation that allows for more than a single moment of future and/or more than a single counterfactual index, the quantity of indices referred to by the realis is smaller than that referred to by the distal. For my proposal to be as concrete as possible, I suggest the following principle:

(33) **Simplicity Principle of Production (SPP)**: Always choose the TAM marker quantifying over the narrowest possible modal-temporal domain.

This principle is a straightforward extension of Gricean Quantity to TAM expressions and in direct contradiction to Cable (2017)'s principle in (28).

To derive the interpretation of the distal, I also need to adapt an interpretation principle that, by default, a TAM expression is understood to the world and time of utterance. In the context of tense semantics, a hierarchy of defaults has already been suggested in the literature:

(34) **Simplicity Hierarchy of temporal references** (cf. Mucha 2015: 69, following Smith et al. 2007):
present > past > future

I propose to extend this hierarchy to the modal dimension of TAM meanings in the following way:

(35) **Simplicity Hierarchy of Modal-Temporal Domains**:
actual present > actual past > possible futures > counterfactual past/present/futures

I can at this point not explore whether the counterfactual past, present and futures are internally ranked, or how this hierarchy might look. For our purposes, it should suffice to say that reference to counterfactual worlds is less preferred relative to reference to the actual past and present and to the possible futures.

With these definitions and principles in place, we can now walk through the pragmatic process that generates the discontinuity interpretation:

1. The speaker uses the distal marker.
2. Let us assume that nothing in the context suggests that counterfactual events are relevant.
3. By (35), the default interpretation for the distal marker is a reference to the actual past.
4. But if the speaker wants to talk about the actual past, she should just have used the realis, by principle (33).
5. Then, the violation of (33) triggers the discontinuity implicature.

Thus, by defining the modal implications of the distal marker in terms that make them directly comparable to the realis marker, we can operationalize the Gricean principle of Quantity to derive the discontinuity implicature.

7. Conclusion

The Daakaka distal matches the cross-linguistic criteria for a marker of discontinuous past. Contrary to the hypothesis by Plungian and van der Auwera (2006), its discontinuity reading is probably not lexically derived, but a pragmatic function of its contrast to the realis marker. Contrary to the generalization by Cable (2017), Daakaka is not an optional-tense language. I have argued that the discontinuity reading of the distal marker cannot derive from a scalar contrast to the realis marker and that in fact the implicature would be quite puzzling if we only take into account the temporal dimensions of its meaning. However, if we also consider its modal dimension, we can still appeal to the Gricean maxim of Quantity to derive the discontinuity implicature.

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Saving monotonic modals with ranked ordering sources[1]

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Abstract. In this paper, I argue that Jackson (1985)'s Professor Procrastinate (PrP) problem is not inconsistent with a quantificational semantics for deontic modals. In particular, the apparent inability to infer $ought(\phi)$ from $ought(\phi \wedge \psi)$ is because the modals in the two sentences are interpreted with respect to two distinct ordering sources, and these contexts differ in the relative ranking that they assign to different priorities. I show how formalisms for modeling contextual priority rankings—particularly the ordered merging operation (Katz et al., 2012) and ranked ordering sources (Reisinger, 2016)—account for the PrP problem and argue that ranked ordering sources better account for priority-sensitive modals in embedded contexts.

Keywords: modality, ordering semantics, monotonicity.

1. Introduction

The main data point I consider in this paper is the Professor Procrastinate (PrP) problem, raised by Jackson (1985) to argue against the distributivity of *ought* over conjunction in deontic logic. The problem takes place in the following scenario.[2]

> Professor Procrastinate is the leading researcher in her field, and accordingly she has been invited to review a book on that topic. A review written by Prof. Procrastinate will be significantly more valuable to the scholarly community than one written by anyone else. Unfortunately, she has a habit of putting off her work, and if she accepts the invitation, she is extremely unlikely to finish the review on time. If she declines, then the editor will find someone else to write the review, and this would be a better outcome than no review at all.

In this scenario, Jackson judges (1) to be true and (2) to be false.

(1) Prof. Procrastinate ought to accept and write the review.

(2) Prof. Procrastinate ought to accept.

On this basis, he argues that the inference from $ought(\phi \wedge \psi)$ to $ought(\phi)$ is invalid, where in this case ϕ is *Prof. Procrastinate accepts* and ψ is *Prof. Procrastinate writes the review*. Lassiter (2011) moves this problem from deontic logic to natural language semantics as part of his argument that deontic modals are not upward monotonic. This is a critical argument against a standard quantificational semantics for modals, which predicts that modals are upward monotonic, but the argument only goes through if the modals in (1) and (2) quantify over the same set of possible worlds, which in Kratzer (1991)'s semantics corresponds to interpretation

[1] I want to thank Kyle Rawlins, Aaron Steven White, Justin Bledin, Paul Smolensky, and Daniel Lassiter for their suggestions, feedback, and encouragement at various stages of this project.

[2] This version of the PrP scenario is based more closely on Lassiter (2011)'s presentation, which, along with Jackson and Pargetter (1986), simplifies the original description of the PrP problem from Jackson (1985).

with respect to the same conversational backgrounds. I will argue in this paper that these sentences are interpreted under two different *ordering sources*, and that these ordering sources encode different relative rankings of priorities. Hence, the PrP problem is consistent with a quantificational modal semantics that can encode this contextual priority ranking difference.

I begin in Section 2 by reviewing the PrP problem in more detail, and in Section 3 I outline how the problem challenges standard quantificational accounts of modality. In Section 4, I present a solution to the PrP problem in which (1) and (2) are interpreted under ordering sources encoding different priority rankings. This solution motivates comparing different formalisms for encoding priority rankings, and hence I show in Section 5 that an embedded modification of the PrP problem supports Reisinger (2016)'s *ranked ordering source* account over the *ordered merging operation* from Katz et al. (2012). Finally, in Section 6, I consider additional data with implications for how contextual priorities are encoded and suggest applications of priority ranking formalisms to other questions in modal semantics.

2. The Professor Procrastinate problem

First, I take a closer look at the readings of the PrP problem sentences (1) and (2) in this scenario. Recall that the three possible outcomes in the PrP scenario, in decreasing order of desirability, are

- that Prof. Procrastinate accepts the invite and, against all odds, actually writes the review;
- that she declines the invite, and someone else writes the review; and
- that she accepts the invite and fails to write the review.

Furthermore, if she accepts the invite, it is much more likely that she will not write the review than that she will. In this scenario, Jackson (1985) judges (1) to be true. This intuition is straightforward, as accepting the invitation and writing the review leads to the most desirable outcome. To understand why he judges (2) to be false, we need to remember that by far the most likely consequence of accepting the invite is that no review gets written—the *least* desirable outcome—even though accepting is also a prerequisite for the *most* desirable outcome.

This is not the only reading for (2), however. One could also judge the sentence to be true if one also holds Prof. Procrastinate responsible for overcoming her procrastination habit. This contrast is clarified by the continuations in (3)

(3) a. Prof. Procrastinate ought not to accept. If she does, she almost certainly won't write the review. (Jackson's intended reading)
b. Prof. Procrastinate ought to accept. And she better actually write the review if she does!

Hence, the PrP problem places at least two empirical constraints on a theory of natural language modals. First, the theory must account for both the truth of (1) and the falsity of (2); I show in the next section that this constraint is not trivial to satisfy with a standard quantificational modal semantics. Second, it should be flexible enough to allow both readings in (3).

3. The challenge for quantificational semantics

In this section, I review why, as Lassiter (2011) points out, the PrP problem challenges standard quantificational accounts of modality and outline how that challenge can be resolved.

First, recall the doubly relative modal semantics developed by Kratzer (1981, 1991), in which a modal expression is evaluated with respect to a pair of *conversational backgrounds*—functions from possible worlds to sets of propositions—supplied by context. One conversational background is the *modal base*, commonly denoted by f, which maps a world w to a set of relevant facts or body of information in w. The other is the *ordering source*, denoted by g, which maps w to a set of norms, desires, laws, goals, or so on, depending on the type of ordering source. The denotation of a necessity[3] modal like *ought* is given in (4).

(4) $[\![\text{ought}]\!]^{w_@,f,g} = \lambda p_{\langle s,t\rangle} \,.\, \forall w \in \max_{g(w_@)}(\bigcap f(w_@)) : p(w)$

In this denotation, $\max_P(W)$ denotes the maximal worlds in W according to the preorder $\leq_P$, which ranks a world u above another world v if every proposition in P satisfied by v is also satisfied by u:

(5) $v \leq_P u$ iff $\forall p \in P : p(v) \rightarrow p(u)$

What is important for the current discussion is that the truth of $[\![\text{ought}]\!]^{w_@,f,g}(p)$ depends on whether p holds throughout a contextually determined domain of quantification that depends on the world of evaluation $w_@$ and the conversational backgrounds f and g. This is enough to show that the modal semantics in (4) is upward monotonic in its prejacent. That is, if p and q are propositions such that $p \subseteq q$, then $[\![\text{ought}]\!]^{f,g}(p)$ implies $[\![\text{ought}]\!]^{f,g}(q)$. For if all worlds in the domain of quantification are in p, then by assumption they are also in q. Because $p \wedge q \subseteq p$ for any p and q, distribution over conjunction follows as a special case of monotonicity. Thus, *assuming a fixed choice of conversational backgrounds*, this semantics cannot account for the simultaneous truth of (1) and falsity of (2), which are reproduced as (6) and (7), respectively.

(6) Prof. Procrastinate ought to accept and write the review.

(7) Prof. Procrastinate ought to accept.

One reaction to this problem is to adopt a modal semantics that does not license monotonic inferences. For example, Lassiter (2011) proposes a scalar semantics for deontic and bouletic modals in which $ought(p)$ is true if, given some probability measure on propositions and a utility random variable, the expected utility conditioned on p being true exceeds a contextually provided threshold. Such a semantics is non-monotonic in either direction. In particular, the expected utility conditioned on some $p \wedge q$ may exceed a threshold even if the expected utility

[3]For now, I gloss over the distinction between weak and strong necessity modals.

conditioned on p alone does not if the worlds in $p \wedge \neg q$ have sufficiently low utility and high probability.

An alternative strategy, which I pursue in this paper, is to argue that the contextual parameters used to interpret (6) and (7) are not actually the same. If the two sentences are interpreted under different conversational backgrounds, then their modal quantification domains will also generally differ, and hence there is no reason to expect any particular logical relation between them to hold.

Nevertheless, if there is a difference in contextual parameters used to interpret (6) and (7), it is not obvious what that difference is. If the modal bases differ, then there should be a difference in the relevant facts or body of information used to interpret the sentences. If the ordering sources differ, then some criteria by which an outcome is judged to be desirable, morally good, or legally permissible must differ. Thus, the burden falls on the proponent of this solution to explicitly describe this contextual difference; I do this in the next section.

4. Solving the problem with priority ranking

I now propose a solution to the PrP problem that relies on what I will call *priority rankings* on ordering sources. First, I lay out a simple model of the PrP scenario and establish some notation for the rest of the paper. Next, I motivate the concept of priority rankings and show how it solves the PrP problem by blocking the inference from (6) to (7) with their intended readings. I then discuss a couple of ways to implement it formally in a quantificational modal semantics.

4.1. A model of the PrP scenario

Let *Accept* be the proposition that Prof. Procrastinate accepts the invitation to write the review, let *ProfWrite* be the proposition that she writes the review, and let *OtherWrite* be the proposition that someone else writes the review. Additionally, let *Focused* be the proposition that Prof. Procrastinate is in the right state of mind, is sufficiently organized, and so on such that she would be able to complete the review if she accepted the invitation.

These propositions are sufficient to characterize the possible outcomes in the PrP scenario as well as their causes. For example, we can capture that someone else will write the review exactly if Prof. Procrastinate rejects the invite ($\mathit{OtherWrite} \leftrightarrow \neg \mathit{Accept}$), that the outcome of accepting the invitation depends on whether she procrastinates or not ($\mathit{Accept} \rightarrow (\mathit{ProfWrite} \leftrightarrow \mathit{Focused})$), and so on. These background facts that are relevant to interpreting the modals in (6) and (7) are captured by the modal base f, which should contain these propositions when evaluated at the actual world.

These propositions are also sufficient to define certain orderings on possible worlds that are relevant to the PrP scenario. One such ordering, which I denote $\leq_{DES}$, captures the relative goodness or desirability of worlds. In this case, the worlds in which Prof. Procrastinate writes the review are ranked above those in which someone else writes the review, which in turn are ranked above those in which no one writes the review. Note that these outcomes exhaust all possibilities given the modal base.

(8) $\neg \mathit{ProfWrite} \wedge \neg \mathit{OtherWrite} <_{DES} \mathit{OtherWrite} <_{DES} \mathit{ProfWrite}$

Another, simpler ordering $\leq_{LH}$ captures the relative likelihood of events. In particular, given Prof. Procrastinate's poor work habits, it is more likely that she is not focused than that she is:

(9) $\mathit{Focused} <_{LH} \neg \mathit{Focused}$

Both of these orderings will need to be derived from appropriate ordering sources, but I leave these details to Section 4.3.

Note also that the valuation of every proposition in this scenario is completely characterized by the valuations of *Accept* and *Focused*. That is, knowing whether each of these two propositions is true in a world is enough to know the truth value of every relevant proposition in that world. Thus, there are four relevant equivalence classes of possible worlds, which I will denote AF, $\neg AF$, $A\neg F$, and $\neg A\neg F$. This model is summarized in Table 1.

World	*ProfWrite*	*OtherWrite*	*DES* rank	*LH* rank
AF	✓	✗	3	1
$\neg AF$	✗	✓	2	1
$A\neg F$	✗	✗	1	2
$\neg A\neg F$	✗	✓	2	2

Table 1: The equivalence classes of possible worlds in the PrP scenario. The first three columns give the valuations of all relevant propositions in the model, and the last two give the rankings of the equivalence classes according to the orders $\leq_{DES}$ and $\leq_{LH}$ where higher ranks are more desirable or likely, respectively.

4.2. The concept of priority ranking

One way to characterize the intuitive challenge of the PrP scenario is that it puts two competing sets of priorities or constraints into conflict. In this case, the constraint that outcomes be as desirable as possible conflicts with the constraint that outcomes be realistic or attainable. If this conflict is resolved in different ways, then the outcomes that best satisfy the competing constraints will also change. In particular, if a modal's domain of quantification depends on how such a conflict is resolved, then its truth conditions will also depend on that resolution.

This intuition motivates the concept of *priority ranking* in the interpretation of modals. At a high level, if two potentially conflicting priorities are used to compute the set of maximal possible worlds in a modal's domain of quantification, then we defer to the higher-ranked priority when the two priorities conflict. More formally, since the Kratzer's modal semantics makes use of preorders over possible worlds, suppose that we have two such preorders $\leq_A$ and $\leq_B$. Then using the order $\leq_{A*B}$ defined in (10) corresponds to ranking $\leq_A$ over $\leq_B$.[4]

(10) $u \leq_{A*B} v$ iff $u <_A v$ or ($u \cong_A v$ and $u \leq_B v$)

That is, $\leq_{A*B}$ orders worlds by first consulting $\leq_A$ and then only falling back to $\leq_B$ if $\leq_A$ is indifferent. To see how priority rankings help us solve the PrP problem, first consider the possible rankings of $\leq_{DES}$ and $\leq_{LH}$ from the previous section. These orders are summarized in Figure 1.

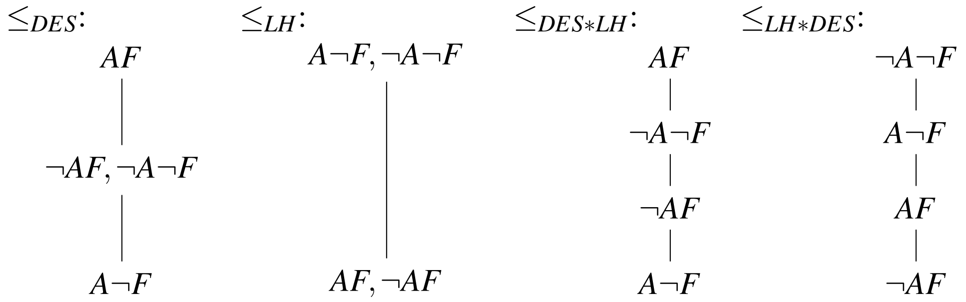

Figure 1: The orders $\leq_{DES}$ and $\leq_{LH}$ along with their possible priority rankings.

In all of the optimal worlds under $\leq_{DES*LH}$ (and in fact under $\leq_{DES}$), Prof. Procrastinate accepts the invitation and writes the review. In all of the optimal worlds under $\leq_{LH*DES}$, Prof. Procrastinate does not accept the invitation. Thus, if the modals in (11) and (12) are interpreted using the world orderings $\leq_{DES*LH}$ and $\leq_{LH*DES}$, respectively, we recover Jackson's judgments on these sentences despite using a quantificational semantics for *ought*.

(11) Prof. Procrastinate ought to accept and write the review.

(12) Prof. Procrastinate ought to accept.

Additionally, priority rankings neatly account for the different readings in (13) that were pointed out in Section 2. In particular, the first sentence in (13a) is true under the ordering $\leq_{LH*DES}$, and the one in (13b) is true under $\leq_{DES*LH}$ (or in fact under $\leq_{DES}$).

(13) a. Prof. Procrastinate ought not to accept. If she does, she almost certainly won't write the review.
b. Prof. Procrastinate ought to accept. And she better actually write the review if she does!

Not only does a priority ranking account have the formal degrees of freedom to account for both of these readings, but it does so in a way that reflects the intuitive difference between them. In particular, the reasoning that would cause someone to utter (13a) places high weight on the likelihood that desirable outcomes actually occur ($\leq_{LH*DES}$), and the rationale for (13b) must

[4]Here I use $u \cong_A v$ as an abbreviation for $u \leq_A v$ and $v \leq_A u$. In the special case where $\leq_A$ is a *partial* order, $u \cong_A v$ reduces to $u = v$.

be willing to overlook ($\leq_{DES*LH}$) or even disregard ($\leq_{DES}$) the low probability of a desirable outcome. Thus, a priority-ranking-based account can meet both of the empirical challenges raised by the PrP problem.

4.3. Implementing priority rankings in Kratzer's semantics

In the preceding discussion, I have shown how a Kratzerian modal semantics that has access to the priority ranking preorders $\leq_{LH*DES}$ and $\leq_{DES*LH}$ can account for the PrP problem. Nevertheless, in Kratzer's semantics, modals are not directly parametrized by a preorder over possible worlds. Rather, a world preorder is derived from an ordering source as described in Section 3. Thus, in this section, I review formalisms from Katz et al. (2012) and Reisinger (2016) that derive priority ranking preorders from conversational backgrounds and show how they model the PrP scenario.

4.3.1. Ordered merging

The first of these formalisms is the *ordered merging operation* from Katz et al. (2012), the first proposed formalism for implementing priority rankings over ordering sources in a Kratzerian semantics. The operation, denoted by $*$, is a binary operation on sets of propositions with the following property: If P and Q are sets of propositions that induce preorders $\leq_P$ and $\leq_Q$, then $P*Q$ is a set of propositions that induces the preorder $\leq_{P*Q}$ that ranks $\leq_P$ over $\leq_Q$. For completeness, the definition of $*$ is in (14), though the preceding property of $*$ is enough for the current discussion.

(14) $$P*Q = \\ P\cup\{q\wedge\bigwedge P \mid q\in Q\}\cup\{q\vee\bigvee P \mid q\in Q\}\cup\{(q\wedge P_n)\vee P_{n+1} \mid 0<n<|P|, q\in Q\} \\ \text{where } P_k = \bigvee_{\substack{R\subseteq P\\|R|=k}}\bigwedge R$$

The operation is extended from sets of propositions to ordering sources in the natural way: $(g_1 * g_2)(w) = g_1(w) * g_2(w)$.

To see how this operation applies the the PrP problem, I define two ordering sources, g_{DES} and g_{LH}, that induce the orders $\leq_{DES}$ and $\leq_{LH}$ when evaluated at $w_@$.

(15) $$g_{DES}(w_@) = \{\mathit{ProfWrite}, \neg\mathit{ProfWrite}\rightarrow\mathit{OtherWrite}\} \\ g_{LH}(w_@) = \{\neg F\}$$

After some work, we can compute the ordered merge of these sets of propositions:[5]

(16) $$g_{LH}(w_@) * g_{DES}(w_@) = \{\neg F, P\wedge\neg F, P\vee\neg F, (\neg P\rightarrow O)\wedge\neg F\}$$

Indeed, the order that $g_{LH} * g_{DES}$ induces is exactly $\leq_{LH*DES}$ from the previous section. Similarly, $\leq_{DES*LH}$ is induced by $g_{DES} * g_{LH}$, which is computed below.

[5] *ProfWrite* is abbreviated P, and *OtherWrite* is abbreviated O

(17) $g_{DES}(w_@) * g_{LH}(w_@) = \{P, \neg P \rightarrow O, \neg F \wedge P, \neg F \vee P \vee O, P \vee (\neg F \wedge O)\}$

Thus, the ordered merging operation can account for each of the PrP problem readings by using the ordering source $g_{LH} * g_{DES}$ or $g_{DES} * g_{LH}$ as appropriate.

4.3.2. Ranked ordering sources

An alternative formalism that captures priority rankings is Reisinger (2016)'s *ranked ordering sources*. In contrast to the ordered merging operation previously described, which involves no modification to Kratzer's semantics, ranked ordering sources require minor changes to the way ordering sources induce preorders on possible worlds.

In particular, ranked ordering sources are functions from possible worlds to *partially ordered* sets (posets) of propositions. Equivalently, they can be thought of as pairs $(g, \prec)$, where g is a conventional (unordered) conversational background, and $\prec$ is a function that maps w to a partial order on the set of propositions $g(w)$. For any two propositions $p, q \in g(w)$, the statement $p \prec_w q$ can be read as "q has higher priority than p." When discussing ranked ordering sources, the term *priority order* will refer to the ordering $\prec$.

Intuitively, propositions ranked higher by the priority order have greater weight in determining the preorder on possible worlds. This intuition is formalized in (18).[6]

(18) $u \leq_{P,\prec} v$ iff $\forall p \in P : (p(u) \wedge \neg p(v)) \rightarrow (\exists q \in P : q(v) \wedge \neg q(u) \wedge p \preceq q)$

That is, for each ordering source proposition p that would rank u above v, there is another proposition q that ranks v above u and that has higher priority than p.

With these definitions, it is simple to specify a model of the PrP scenario. Let $g_{LH}(w_@)$ be defined as before (with a trivial priority order), and let $g_{DES}(w_@) = \{\mathit{ProfWrite}, \mathit{OtherWrite}\}$, where $\mathit{OtherWrite} \prec_{w_@} \mathit{ProfWrite}$; note that this captures the fact that *ProfWrite* is a better outcome than *OtherWrite* using the partial order structure of g_{DES}, whereas the previous formalism had to do so using a material conditional. As before, $g_{LH}(w_@)$ and $g_{DES}(w_@)$ induce the preorders $\leq_{LH}$ and $\leq_{DES}$, respectively, via the order defined in (18).

To derive priority rankings on ranked ordering sources, Reisinger (2016) introduces the priority join operation $\sqcup$, which can be thought of as an extension of the ordered merge operation $*$ to partially ordered sets. Given two ranked ordering sources $(g, \prec)$ and $(h, \prec')$, their priority join $(g, \prec) \sqcup (h, \prec')$ is $(g \cup h, \prec^{\sqcup})$, where $\prec^{\sqcup}$ is defined in (19) and where the $\min_w$ and $\max_w$ operators compute which of a pair of ordering sources has lower or higher priority ranking in a given possible world w.[7]

[6] In the special case where $\prec$ is a total order, then computing the maximal worlds under $\leq_{P,\prec}$ is equivalent to optimization in the sense of Optimality Theory (Prince and Smolensky, 2008), where the output candidates are possible worlds, and the constraints are the propositions in P ordered by $\prec$.

[7] This formulation of the priority join differs slightly from the one in Reisinger (2016), where the join takes a third contextual parameter determining the priority ranking at each possible world. In the current formulation, these priority rankings are assumed to be specified by each possible world.

(19) $$p \prec^{\sqcup}_{w} q \text{ iff } p,q \in g_{max}(w) \text{ and } p \prec^{max}_{w} q \text{ or}$$
$$q \in g_{max}(w) \text{ and } p \in g_{min}(w) - g_{max}(w) \text{ or}$$
$$p,q \in g_{min}(w) - g_{max}(w) \text{ and } p \prec^{min}_{w} q$$

$$\text{where } (g_{min}, \prec^{min}) = \min_w((g,\prec),(h,\prec')) \text{ and}$$
$$(g_{max}, \prec^{max}) = \max_w((g,\prec),(h,\prec'))$$

That is, there are two ways for p to have lower priority than q. The first and third clauses say that if p has lower priority than q in either of the operand ordering sources, then it also has lower priority in the join. The second clause says that p has lower priority than q if p and q are members of the lower and higher priority ranked operands, respectively. Intuitively, the join $(g,\prec) \sqcup (h,\prec')$ "glues" one of the partial orders on top of the other, depending on which ordering source has higher priority in a given world.

To see how this applies to the PrP problem, let $g = g_{LH} \sqcup g_{DES}$. If g_{LH} has higher priority than g_{DES} in $w_@$—that is, if $\max_{w_@}(g_{LH}, g_{DES}) = g_{LH}$—then $g(w_@)$ has the following priority order: $\mathit{OtherWrite} \prec_w \mathit{ProfWrite} \prec_w \neg F$. The reader can check that this ranked ordering source induces the preorder $\leq_{LH*DES}$. Alternatively, in a world w where g_{DES} has higher priority, the priority order is $\neg F \prec_{w_@} \mathit{OtherWrite} \prec_{w_@} \mathit{ProfWrite}$, and in this case $g(w)$ induces the preorder $\leq_{DES*LH}$. In both cases, the priority relation within g_{DES} is left intact. This join is represented schematically in Figure 2.

$$\begin{array}{ccccccc}
(\leq_{LH}) & & (\leq_{DES}) & & (\leq_{LH*DES}) & & (\leq_{DES*LH}) \\
 & & & & \neg F & & P \\
 & & P & & | & & | \\
\neg F & \sqcup & | & = & P & \text{or} & O \\
 & & O & & | & & | \\
 & & & & O & & \neg F
\end{array}$$

Figure 2: Possible values of the priority join $(g_{LH} \sqcup g_{DES})(w_@)$, depending on the priority ranking of g_{LH} and g_{DES} at $w_@$. In parentheses above each poset of propositions is the world preorder that it induces.

Thus, ranked ordering sources and the priority join operation, like the ordered merging operation in the previous section, are a way to implement a priority ranking solution to the PrP problem in Kratzer's modal semantics. In the next section, I discuss some differences between these two formalisms.

5. Priority rankings in embedded contexts

Many of the differences between the ordered merging and ranked ordering source implementations of priority rankings are purely formal. For example, the ordered merge operation implements priority rankings without any modification to Kratzer's ordering semantics, whereas ranked ordering sources capture priority rankings with intuitively transparent formal representations; compare the priority joins in Figure 2 with the merged ordering sources in (16) and (17).

Nevertheless, there is at least one difference that has empirical consequences. In an ordered merging account, the priority ranking is fixed by the choice of ordering source, which in turn is presumably determined by the context of utterance. For example, $g_{LH} * g_{DES}$ and $g_{DES} * g_{LH}$ are two different ordering sources that encode two different priority rankings relating g_{LH} and g_{DES}. In contrast, the priority join $g_{LH} \sqcup g_{DES}$ allows the priority ranking to vary with the world of evaluation. This difference is significant in sentences like (20), where a priority-sensitive modal (*ought*) is in an embedded context that shifts the world of evaluation (the complement of *thinks*).

(20) Prof. Procrastinate ought not to accept, but Kat thinks that she ought to.

In particular, (20) has a reading under which Kat and the speaker agree on the facts behind the PrP scenario, including the relative likelihood and utility of outcomes, but differ in the kind of moral reasoning used to determine what Prof. Procrastinate should do. In other words, (20) can entail that the speaker and Kat disagree on how to prioritize the outcome feasibility and desirability.

The ordered merging account in Section 4.3.1 does not predict that (20) has this reading. I assume here that *think* has the standard neo-Hintikkan denotation in (21), where $Dox_x(w_@)$ is the set of worlds doxastically accessible from $w_@$ by entity x.

(21) $[\![\text{think}]\!]^{f,g,w_@} = \lambda p_{\langle s,t \rangle} \,.\, \lambda x_e \,.\, \forall w \in Dox_x(w_@) : p(w)$

We can model the fact that Kat and the speaker agree on the relevant facts of the PrP scenario with the conditions in (22), that the modal base, likelihood ordering source, and desirability ordering source all have the same values in Kat's doxastically accessible worlds as in the world of evaluation.

(22) $\forall w \in Dox_{Kat}(w_@)$:
a. $f(w) = f(w_@)$
b. $g_{LH}(w) = g_{LH}(w_@)$
c. $g_{DES}(w) = g_{DES}(w_@)$

From this it follows that $(g_{LH} * g_{DES})(w)$ and $(g_{DES} * g_{LH})(w)$ agree with their values at $w_@$ for all w in $Dox_{Kat}(w_@)$, and hence the domains of quantification for both instances of *ought* in (20) are the same. Thus, this account predicts that (20) is a contradiction regardless of which priority ranking is used to interpret it, since the first conjunct requires all worlds in the domain of quantification to be $\neg A$ worlds while the second requires them to be A worlds.

In contrast, a ranked ordering source account makes no such prediction. In particular, suppose that g_{LH} has higher priority than g_{DES} in $w_@$ and that the reverse is true for each w in $Dox_{Kat}(w_@)$. Then $g_{LH} \sqcup g_{DES}$ induces the preorder $\leq_{LH*DES}$ (with maximal worlds $\neg A \neg F$) at

$w_@$ and $\leq_{DES*LH}$ (with maximal worlds AF) within $Dox_{Kat}(w_@)$, and hence both conjuncts of (20) are predicted to be true under the priority join.

Thus, on the basis of sentences like (20), I argue that we need accounts of priority rankings that, like ranked ordering sources, allow relative priority to vary with the world of evaluation.

6. Further implications and future directions

In this section, I begin by pointing out additional empirical and theoretical consequences of the priority ranking solutions to the PrP problem, particularly in comparison to non-monotonic alternatives, by focusing on the possible readings of *ought*(*Accept*), which has been taken by Jackson (1985) and others in the literature to be false. I then conclude by drawing connections between priority rankings and a variety of related topics in the modality literature for further investigation.

6.1. Revisiting Jackson's judgment

First, I claim that Lassiter (2011)'s scalar semantics for deontic modals alluded to in Section 3 accounts for the possible readings of (23) very differently from either of the quantificational priority ranking analyses.

(23) Prof. Procrastinate ought to accept.

A simplified version of Lassiter's semantics for *ought* is given in (24), where I use $\mathbb{E}(p)$ to denote the expected utility conditioned on a proposition p given some probability and utility functions on possible worlds and θ is a contextually determined threshold.

(24) $[\![\text{ought}]\!]^{\theta} = \lambda p_{\langle s,t\rangle} \,.\, \mathbb{E}(p) \geq \theta$

Even in this form, there are clear differences between the scalar and priority ranking accounts for (23). First, since the PrP scenario is reasonably modeled by assuming at least that $\mathbb{E}(Accept \wedge ProfWrite) > \mathbb{E}(Accept)$, there are three different regimes that θ can fall in. If $\theta \leq \mathbb{E}(Accept)$, then both *ought*(*Accept*) and *ought*($Accept \wedge ProfWrite$) are true, and if $\theta > \mathbb{E}(Accept \wedge ProfWrite)$, both *ought* statements are false. Finally, if θ is between these two expected utility values, then *ought*($Accept \wedge ProfWrite$) is true while *ought*(*Accept*) is false, exactly as judged by Jackson (1985).

Thus, the only way for someone to judge (23) as true is that the standard for things one ought to do, θ, be sufficiently low, assuming that person correctly understands the PrP scenario. In constrast, under a priority ranking account, (23) can be judged true by someone who uses a different (perhaps normatively irrational) mode of moral reasoning that discounts the role of outcome plausibility.

Lassiter also posits additional conditions on the threshold θ in order to, among other goals, differentiate between strong necessity, weak necessity, and possibility modals in a scalar framework. For weak necessity modals like *ought*, θ must be significantly greater than the expected utility of some set of relevant alternatives to the prejacent. In the case of (23), the relevant alternative is $\neg Accept$. But since $\mathbb{E}(Accept) < \mathbb{E}(\neg Accept)$ in the PrP scenario, this implies that any θ low enough to make (23) true will also violate this constraint. Thus, this stronger version of Lassiter's analysis predicts that (23) *cannot* be judged true by a competent speaker of English who correctly understands the PrP scenario.

These distinct analyses of (23) are difficult to distinguish empirically as it is difficult to ensure that an informant has a correct understanding of the scenario. Nevertheless, I suspect that an account that requires (23) to be false in the PrP scenario *for semantic reasons* too strongly encodes rational norms of decision making under uncertainly into the meaning of natural language modals.

Additionally, the ordered merging and ranked ordering source accounts tell slightly different stories about the conditions under which (23) can be judged true. Using the ordered merging operation, there are two possible merged ordering sources that encode two possible priority rankings, $g_{LH} * g_{DES}$ and $g_{DES} * g_{LH}$, and (23) is false under the former and true under the latter. Using the priority join operation, however, there is only a single ordering source, $g_{LH} \sqcup g_{DES}$, that encodes a priority ranking relation between likelihood and desirability, and whether the sentence is true or not depends on which priority ranking holds in the world of evaluation (although note that the sentence is true under g_{DES} alone). This difference is subtle, but it bears on disagreement data like the dialogue in (25), where I assume A and B are both speakers who agree on the likelihood and desirability of outcomes in the PrP problem.

(25) A: Prof. Procrastinate ought to accept the invitation, right?
B: No! She really ought not to. She wouldn't write the review if she did.

If the difference between A's and B's position is just a matter of which ordering source is used to interpret the modal, as it would be using the ordered merging account, then this disagreement is odd, as A and B are asserting two mutually compatible propositions. On the other hand, under a priority join analysis, A and B disagree about whether $ought(Accept)$ is true under the ordering source $g_{LH} \sqcup g_{DES}$. That is, since the priority ranking between g_{LH} and g_{DES} is a matter of fact in a given possible world, A and B can debate which kind of world they are actually in. Thus, to the extent that a dialogue like (25) can occur without some kind of misunderstanding between the participants, I argue that the priority join is a better model of this kind of disagreement.

6.2. Priority rankings in other domains

Although in this paper and in Reisinger (2016), I have primarily motivated priority rankings through the study of deontic modals under conditions of uncertainty, there are a variety of other topics in modal semantics where formalisms similar to priority rankings have been applied or where they are likely to be appropriate.

One such topic, which was one of the motivations for the ordered merging operation in Katz et al. (2012) as well as one of Lassiter (2011)'s main empirical targets, is the study of gradable modal expressions, such as modal expressions appearing with degree modifiers or in comparative constructions. In a ranked ordering source framework, it is tempting to paraphrase a sentence like (26a) with an expression like (26b), where $\prec$ is the priority order for a deontic ordering source.

(26) a. It is more illegal to commit murder than to jaywalk.
b. $\lambda w_s \,.\, \neg \mathit{Jaywalk} \prec_w \neg \mathit{Murder}$

Thus, it may be desirable for a modal degree semantics that makes use of ordering sources, such as the one proposed by Portner and Rubinstein (2016), to be consistent with such priority order paraphrases (or vice versa).

Additionally, similar formalisms in which multiple ordering sources contribute to a modal domain of quantification with different degrees of priority have been proposed to model other phenomena. For example, von Fintel and Iatridou (2008) explain why weak necessity modals are logically weaker than strong necessity modals in terms of an additional ordering source, called a *secondary* ordering source, that is used to further winnow down a weak necessity modal's domain of quantification after the primary ordering source has already been applied. This is equivalent to optimizing under a priority ranked pair of ordering sources in which the primary ordering source is ranked above the secondary. Furthermore, Rubinstein (2012) shows that the difference between primary and secondary ordering sources corresponds to a difference in discourse commitments by conversational participants. In particular, primary ordering sources are those that are collectively committed to by all participants, whereas secondary ordering sources may only be committed to by the speaker. Thus, if the primary/secondary distinction can be modeled using priority rankings, it is natural to wonder whether similar discourse constraints apply to priority rankings more generally.

7. Conclusion

In this paper, I have addressed a potent objection to a quantificational semantics for natural language modals raised by the Professor Procrastinate problem. Although this problem has been proposed as evidence against any upward monotonic modal semantics, I have shown that adding a *priority ranking* as an additional contextual degree of freedom circumvents this argument. I have shown how this solution can be implemented using two related formalisms, the *ordered merging operation* of Katz et al. (2012) and Reisinger (2016)'s *ranked ordering sources*, and argued that data involving modals embedded under attitude verbs better accord with the latter. Finally, I have argued that priority rankings are not merely a stopgap measure to save quantificational modals from this one objection, as they have additional empirical and theoretical implications that differ from non-monotonic alternatives and may be applicable to several other areas of research in modal semantics.

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The distributive ignorance puzzle[1]

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Abstract. We observe that verbs like *wonder* do not just imply that their subject does not know the answer to the embedded question, but a stronger form of ignorance, which we call *distributive ignorance*. This is not predicted by existing work on the semantics of *wonder*, and we argue that it cannot be straightforwardly derived as a pragmatic inference either. We consider two possible semantic accounts, and conclude in favor of one on which the lexical semantics of *wonder* involves exhaustification w.r.t. structural alternatives as well as sub-domain alternatives of its complement.

Keywords: *wonder*, ignorance, inquisitive semantics, exhaustivity.

1. Introduction

This paper is concerned with clause-embedding predicates such as *wonder*, *investigate* and *be curious*. These predicates have two things in common. First, in terms of selectional restrictions, they only take interrogative clauses as their complement, not declarative ones:

(1) The doctor **is wondering** what the patient ate / *that the patient ate.

(2) The doctor **is investigating** what the patient ate / *that the patient ate.

(3) The doctor **is curious** what the patient ate / *that the patient ate.

Second, in semantic terms, they each imply, roughly, that their subject is *ignorant* with respect to the issue expressed by the complement and *interested* in resolving this issue.

We will refer to predicates with these two properties as INQUISITIVE PREDICATES,[2] and we will be concerned in this paper with the kind of ignorance that they imply on the part of their subject. Our starting point is a simple but novel empirical observation: when an inquisitive predicate takes an alternative question as its complement, it implies ignorance about all the alternatives introduced. For instance, *John wonders whether Ann, Bill, or Carol arrived* implies that John is ignorant as to whether Ann arrived, as to whether Bill arrived, and as to whether Carol arrived. We will show that this DISTRIBUTIVE IGNORANCE implication is not predicted by existing work on the semantics of *wonder*, even if we take pragmatic strengthening into account. We will then consider two ways of accounting for distributive ignorance: one directly encodes it in the lexical entry for *wonder*, the other derives it as a consequence of a lexicalized

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[2]For Karttunen (1977), the class of inquisitive predicates also includes speech act predicates such as *ask* and *inquire*. We will leave such predicates out of consideration here since they do not semantically imply that the subject is ignorant (although this is often pragmatically implicated). In particular, in examples where the subject is a teacher or a quiz master, it is clear that she need not be ignorant about the answer to the embedded question.

exhaustive inference. We will argue that the exhaustivity-based account is preferable, since it better accounts for distributive ignorance when the complement is a *wh*-question or a polar disjunctive question rather than an alternative question. Throughout, we will focus on the case of *wonder*, but the arguments apply to other inquisitive predicates as well.

The paper is structured as follows: §2 briefly reviews existing work on the semantics of *wonder*; §3 introduces the distributive ignorance puzzle; §4 considers a *pragmatic* account, and the challenges it faces; §5 specifies two *semantic* approaches, and §6 attempts to tease these two apart with additional empirical observations.

2. Background on the semantics of *wonder*

Our theoretical point of departure here is the semantics for *wonder* proposed by Ciardelli and Roelofsen (2015), henceforth C&R.[3] Informally, the idea behind this account is that *wondering* φ amounts to (i) not knowing an answer to the issue expressed by φ, and (ii) entertaining the issue expressed by φ. To make this idea more precise, C&R develop a formal framework called *inquisitive epistemic logic* (IEL), combining notions from standard epistemic logic and inquisitive semantics. We will briefly review the relevant features of the framework, and then spell out the proposed semantics for *wonder*.

Information states and sentence meanings An INFORMATION STATE is modeled in epistemic logic as a set of possible worlds, namely those worlds that are compatible with the information available in the state. The MEANING OF A SENTENCE, whether declarative or interrogative, is modeled in inquisitive semantics as a set of information states, those states where (i) the information conveyed by the sentence is established, and (ii) the issue raised by the sentence is resolved. For instance:

- $[\![\text{Bill left}]\!] = \{s \mid \forall w \in s: \text{ Bill left in } w\}$
- $[\![\text{Did Bill leave}]\!] = \{s \mid \forall w \in s: \text{ Bill left in } w\} \cup \{s \mid \forall w \in s: \text{ Bill did not leave in } w\}$
- $[\![\text{Who left}]\!] = \{s \mid \exists d \in D : \forall w \in s : d \text{ left in } w\}$ [mention-some]

The meaning of a sentence in inquisitive semantics is always non-empty and closed under subsets: if $s \in [\![\varphi]\!]$ and $s' \subset s$ then $s' \in [\![\varphi]\!]$ as well (for motivation of these constraints on sentence meanings, see Ciardelli et al., 2015). The maximal elements of $[\![\varphi]\!]$ are called the ALTERNATIVES in $[\![\varphi]\!]$, denoted $\text{ALT}(\varphi)$. For instance:

- $\text{ALT}(\text{Bill left}) = \{\{w \mid \text{ Bill left in } w\}\}$
- $\text{ALT}(\text{Did Bill leave}) = \{\{w \mid \text{ Bill left in } w\}, \{w \mid \text{ Bill didn't leave in } w\}\}$
- $\text{ALT}(\text{Who left}) = \{\{w \mid d \text{ left in } w\} \mid d \in D\}$ [mention-some]

[3]For a closely related account see Uegaki (2015), and for comparison of the two see Theiler et al. (2016). For earlier informal discussions of the semantics of *wonder*, see Karttunen (1977) and Guerzoni and Sharvit (2007).

Inquisitive states The INQUISITIVE STATE of an agent a, Σ_a, is represented in IEL as a set of information states, namely those information states that resolve all the issues that a entertains. Just like sentence meanings, inquisitive states are also assumed to be non-empty and closed under subsets. Moreover, it is assumed that Σ_a always forms a *cover* of a's information state, denoted as σ_a: $\bigcup \Sigma_a = \sigma_a$ (for motivation of these constraints on Σ_a, see Ciardelli and Roelofsen, 2015). This means that σ_a can always be determined on the basis of Σ_a.

Modal operators, informally IEL has two basic modal operators. Informally, (i) an agent *knows* φ iff her current information state σ_a is a member of $[\![\varphi]\!]$, i.e., one where the issue expressed by φ is resolved, and (ii) an agent *entertains* the issue expressed by φ iff every information state in her inquisitive state is a member of $[\![\varphi]\!]$, i.e., every state that resolves the issues that she entertains is one where the issue expressed by φ is resolved. The semantics of *wonder* is defined in terms of these two basic modal operators. Informally, an agent wonders about φ iff she doesn't know φ but does entertain the issue expressed by φ.

Models and semantics An IEL MODEL for a given set of agents $\mathscr{A}$ and a set of atomic sentences $\mathscr{P}$ is a triple $M = \langle \mathscr{W}, V, \Sigma_{\mathscr{A}} \rangle$, where (i) $\mathscr{W}$ is a set of POSSIBLE WORLDS, (ii) $V : \mathscr{W} \mapsto \wp(\mathscr{P})$ is a VALUATION MAP, and (iii) $\Sigma_{\mathscr{A}} = \{\Sigma_a \mid a \in \mathscr{A}\}$ is a set of INQUISITIVE STATE MAPS, one for each agent $a \in \mathscr{A}$, mapping every world $w \in \mathscr{W}$ to the inquisitive state of a in w, $\Sigma_a(w)$. The information state of a in w, $\sigma_a(w)$, is defined as $\bigcup \Sigma_a(w)$. The semantics for the non-modal fragment of IEL is just that of basic inquisitive semantics. For the knowledge and entertain modality, the semantics is as described informally above:

(4) a. $[\![A]\!] := \{s \mid \forall w \in s : A \in V(w)\}$ for any atomic sentence $A \in \mathscr{P}$
b. $[\![\neg\varphi]\!] := \{s \mid \forall t \in [\![\varphi]\!] : s \cap t = \varnothing\}$
c. $[\![\varphi \wedge \psi]\!] := [\![\varphi]\!] \cap [\![\psi]\!]$
d. $[\![\varphi \vee \psi]\!] := [\![\varphi]\!] \cup [\![\psi]\!]$
e. $[\![K_a\varphi]\!] := \{s \mid \forall w \in s : \sigma_a(w) \in [\![\varphi]\!]\}$
f. $[\![E_a\varphi]\!] := \{s \mid \forall w \in s : \Sigma_a(w) \subseteq [\![\varphi]\!]\}$

If $s \in [\![\varphi]\!]$ we say that s *supports* φ. If φ is supported by a state of complete information $\{w\}$, then we say that φ is *true* in w, notation $w \models \varphi$:

(5) $w \models \varphi \iff \{w\} \in [\![\varphi]\!]$

It follows from the semantics given in (4) that modal statements of the form $K_a\varphi$ and $E_a\varphi$ are supported by a state s if and only if they are true in every world in s. Thus, in the case of modal statements, support is fully determined by truth (this does not hold in general, in particular not for disjunctions). To simplify the exposition, we may therefore just as well focus on the truth-conditions of such statements, which are as follows:

(6) a. $w \models K_a\varphi \iff \sigma_a(w) \in [\![\varphi]\!]$
b. $w \models E_a\varphi \iff \Sigma_a(w) \subseteq [\![\varphi]\!]$

As anticipated above the *wonder* modality in IEL, W, is defined in terms of the basic modal operators K and E, as in (7). This means that it has the truth-conditions specified in (8):

(7) $W_a\varphi := \neg K_a\varphi \wedge E_a\varphi$

(8) $w \models W_a\varphi \iff \sigma_a(w) \notin [\![\varphi]\!] \;\wedge\; \Sigma_a(w) \subseteq [\![\varphi]\!]$

IEL can be extended into a compositional, type-theoretic framework (cf., Ciardelli et al., 2017). English *wonder* can then be translated into the formal language of this framework as follows:

(9) $\ulcorner\text{wonder}\urcorner = \lambda Q_{\langle \mathtt{st},\mathtt{t}\rangle}\lambda x_{\mathtt{e}}.W_x(Q)$

For a full sentence involving *wonder* we then get the following:[4]

(10) a. $\ulcorner$John wonders whether Ann or Bill arrived.$\urcorner = W_j(A \vee B)$

b. $w \models W_j(A\vee B) \iff \sigma_j(w) \notin [\![A\vee B]\!] \;\wedge\; \Sigma_j(w) \subseteq [\![A\vee B]\!]$

c. John's current information state doesn't resolve the question whether A or B, but every information state that resolves the issues that he entertains is one in which the question whether A or B is resolved.

Before closing this background section it is worth mentioning that C&R's semantics predicts that *wonder* does not license declarative complements, assuming that the meaning of a declarative complement always contains a single alternative. Namely, whenever W applies to a sentence whose meaning contains a single alternative, it yields a contradiction.

3. Problem: distributive ignorance

C&R's semantics of *wonder* faces an empirical problem. Consider the following example:

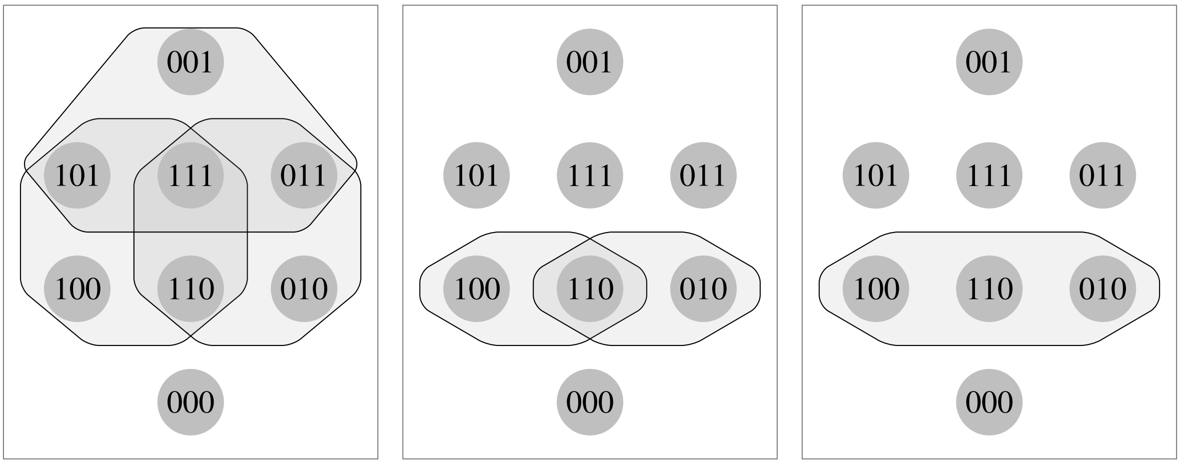
(11) **Situation** John has three students, Ann, Bill and Carol. He is waiting for all of them to arrive at a lab meeting. Someone knocks at the door, but John knows that it can't be Carol because she has just emailed him that she will be late.

Example John wonders whether Ann, Bill or Carol arrived. (Judgment: *False*)

The above example is judged false in the given situation. The sentence is true only if John's information state is compatible with *every alternative* expressed by the complement, i.e., the sets of worlds in which Ann arrived, Bill arrived, and Carol arrived, respectively. Moreover, John's information state should not entail any of these alternatives. Together, this means that the truth of (11) requires that, for each alternative, John is *ignorant* as to whether it holds.

[4] For simplicity, we assume here that the embedded alternative question *whether Ann or Bill arrived* is translated into IEL as $A \vee B$, disregarding the fact that alternative questions presuppose that exactly one of the disjuncts holds. This simplification does not affect the arguments that we will make.

Figure 1: The meaning of the complement, John's inquisitive state Σ_j, and John's information state σ_j in (11). Recall that Σ_j and $[\![A \vee B \vee C]\!]$ are downward-closed; the figures only depict their maximal elements.



(a) $[\![A \vee B \vee C]\!]$ (b) Σ_j (c) σ_j

More generally, for any individual-denoting DP x and any alternative question φ, the sentence *x wonders φ* implies that x is ignorant about each of the alternative answers to φ. We refer to this requirement in the meaning of *wonder* as the DISTRIBUTIVE IGNORANCE requirement. Later, we will discuss in detail what this requirement looks like in examples with *wh*-questions and polar questions. For now, however, let us focus on explaining why the distributive ignorance requirement that arises with alternative questions is a problem for C&R's account.

To see this, consider the example in (11) again. C&R's semantics incorrectly predicts that (11) is *true* in the given situation. This is so since John's current information state does not resolve the question of whether A, B or C, but every information state that resolves the issues that he is entertaining, i.e., every element of his inquisitive state, is one that does resolve the question whether A, B or C. Formally, we have the following:

(12) $\ulcorner$John wonders whether Ann, Bill or Carol arrived.$\urcorner = W_j(A \vee B \vee C)$

(13) $w \models W_j(A \vee B \vee C) \iff \sigma_j(w) \notin [\![A \vee B \vee C]\!]$ and $\Sigma_j(w) \subseteq [\![A \vee B \vee C]\!]$

The meaning of the complement, John's inquisitive state Σ_j, and his information state σ_j are as follows in the given situation (see Figure 1 for graphical representations):

(14) a. $[\![A \vee B \vee C]\!] = [\![A]\!] \cup [\![B]\!] \cup [\![\mathrm{C}]\!]$ (meaning of the complement)

b. $\Sigma_j = \{s \mid s \in [\![A]\!] \cup [\![B]\!]$ and $\forall t \in [\![C]\!] : s \cap t = \varnothing\}$ (John's inquisitive state)

c. $\sigma_j = \{w \mid (w \in \bigcup [\![A]\!]$ or $w \in \bigcup [\![B]\!])$ and $w \notin \bigcup [\![C]\!]\}$ (John's information state)

Thus, the truth conditions in (13) are indeed met in the given situation, since (14c) is not a member of (14a) while (14b) is a subset of (14a). This prediction is incorrect.

4. A pragmatic account and its challenges

4.1. The distributive ignorance requirement as a conversational implicature

Prima facie, one may think that the distributive ignorance requirement could be explained pragmatically, while retaining C&R's semantics for *wonder*. A possible pragmatic derivation of the requirement would go as follows. The speaker of (11) could have uttered another sentence with a *shorter disjunction*, such as the one in (15):

(11) John wonders whether Ann, Bill or Chris arrived.

(15) John wonders whether Ann or Bill arrived.

The alternative in (15) would have been a simpler, presumably still relevant, way to describe John's state. Thus, we could derive the negation of (15) as an implicature, which has the following truth conditions:

(16) $w \models \neg W_j(A \vee B) \iff \sigma_j \in [\![A]\!] \cup [\![B]\!] \text{ or } \Sigma_j \not\subseteq [\![A]\!] \cup [\![B]\!]$

Distributive ignorance can be derived from this implicature, together with the assumed literal meaning of the sentence. Namely, the ignorance condition in the literal meaning implies that $\sigma_j \notin [\![A]\!] \cup [\![B]\!]$. Therefore, for the implicature to hold it must be the case that $\Sigma_j \not\subseteq [\![A]\!] \cup [\![B]\!]$. But the 'entertainment' condition in the literal meaning says that $\Sigma_j \subseteq [\![A]\!] \cup [\![B]\!] \cup [\![C]\!]$. This allows us to conclude that $\Sigma_j \cap [\![C]\!] \neq \{\varnothing\}$, which in turn implies that John's information state, σ_j must be compatible with $\bigcup[\![C]\!]$. Following the same line of reasoning for the other disjuncts, we can derive that σ_j has to be compatible with $\bigcup[\![A]\!]$ and with $\bigcup[\![B]\!]$ as well. At the same time, σ_j cannot entail any of $\bigcup[\![A]\!]$, $\bigcup[\![B]\!]$ and $\bigcup[\![C]\!]$, due to the ignorance condition in the literal meaning. Thus, we derive that John has to be ignorant w.r.t. $\bigcup[\![A]\!]$, $\bigcup[\![B]\!]$, and $\bigcup[\![C]\!]$.

Thus, we see that the distributive ignorance requirement of (11) can be derived as a pragmatic inference. However, there are empirical features of the distributive ignorance requirement which, at face value, do not seem to be in line with the traditional Gricean conception of pragmatic implicatures. Below, we describe three such empirical features.

4.2. Challenges for the pragmatic account

4.2.1. Non-monotonicity of *wonder*

First of all, due to the non-monotonicity of C&R's semantics for *wonder*, the sentence in (15) is actually not stronger than the original sentence in (11). For instance, (15) is true while (11) is false when John's inquisitive state is as follows:

(17) $\Sigma_j = \{s \mid s \in [\![A]\!] \cup [\![B]\!] \text{ and } s \in [\![C]\!]\}$

Since quantity implicatures under the traditional Gricean conception arise only with respect to *strictly stronger* alternatives, the fact that (15) is not strictly stronger than (11) suggests that the inference cannot be treated as a traditional quantity implicature.

One might suggest that the ignorance condition in the semantics of *wonder* could be treated as a presupposition, and that (15) would then indeed asymmetrically entail (11) if we only consider their assertive component, which would consist in the entertainment condition. However, we submit that the ignorance condition of *wonder* is part of its assertive meaning, given that it does not exhibit the projection behavior of presuppositions. The following examples show that it does not project out of (a) negation, (b) polar questions, and (c) the attitude predicate *doubt*, as evidenced by the fact that the underlined continuations are perfectly felicitous.

(18) a. The detectives are not wondering whether Ann stole the jewels.
They already know that she did.
b. A: Are the detectives wondering whether Ann stole the jewels?
B: No, they already know that she did.
c. Bill doubts that the detectives are wondering whether Ann stole the jewels.
He believes that they already know that she stole them.

This contrasts with the behavior of attitude-verb meanings whose presuppositional status is undisputed. For example, the factive presupposition of *know* does exhibit the typical projection behavior, as shown by the oddness of the contradicting continuations in the following examples (in order to become felicitous, these continuations need a marker of presupposition denial such as *actually* or *in fact*).

(19) a. The detectives don't know that Ann stole the jewels.
#She didn't steal them.
b. A: Do the detectives know that Ann stole the jewels?
B: No, they don't. #She didn't steal them.
c. Bill doubts that the detectives know that Ann stole the jewels.
#He doesn't believe that she stole them.

4.2.2. Obligatoriness

The second challenge for a pragmatic account of distributive ignorance is its *obligatory* nature. The following example indicates that distributive ignorance cannot be canceled, contrary to what would be expected under a traditional Gricean approach.

(20) John wonders whether Ann, Bill or Carol arrived.
\# In fact, he already knows that Carol is still at home, but he doesn't know yet whether Ann or Bill arrived.

At this point, it should be mentioned that not all Gricean analyses of implicatures predict cancellability as a necessary feature. In particular, Lauer (2014) points out that Gricean pragmatics predicts that an obligatory implicature arises if an utterance of an expression *necessarily* makes a more preferred expression salient. Lauer (2014) argues that this is exactly the case with the ignorance implicature of unembedded disjunctions since an utterance of the form α *or* β necessarily makes each disjunct salient (see also Westera, 2017).

It is conceivable that Lauer's analysis can be applied to the distributive ignorance requirement of *wonder*, correctly capturing its obligatory nature within a pragmatic approach. However, such an analysis would still face the non-monotonicity issue discussed above, and would also have difficulty capturing the *locality* of distributive ignorance, to which we turn next.

4.2.3. Locality

The distributive ignorance requirement of *wonder* is local, in the sense that it takes scope below operators that are syntactically above *wonder*. The following example illustrates this:

(21) **Situation** There is a crime with three suspects, Ann, Bill, and Carol. There are five detectives investigating the case; one has already ruled out Carol but is still wondering whether it was Ann or Bill. The others don't know anything yet.

Example Exactly four detectives are wondering whether it was Ann, Bill, or Carol.
(Judgment: *true*)

The judgment that this example is *true* can only be accounted for if the distributive ignorance requirement takes scope below the subject quantifier *exactly four detectives*. If the distributive ignorance requirement is derived as a global pragmatic implicature, the sentence would be predicted to be *false*. Here's why: the literal meaning of the given sentence would be that exactly four detectives are such that (i) they don't know whether it was Ann, Bill, or Carol, and (ii) every information state they want to be in resolves the issue of whether it was Ann, Bill, or Carol. This is *false* in the situation above since all five detectives meet these conditions. Adding implicatures to the literal meaning of the sentence could only strengthen it and could thus not make it true in the given situation.

The following example further strengthens our claim that distributive ignorance scopes locally:

(22) **Situation** There is a crime with three suspects, Ann, Bill, and Carol. There are three detectives investigating the case.

- Detective 1 has ruled out Ann but still wonders whether it was Bill or Carol.
- Detective 2 has ruled out Bill but still wonders whether it was Ann or Carol.
- Detective 3 has ruled out Carol but still wonders whether it was Ann or Bill.[5]

[5]We thank Benjamin Spector for drawing our attention to this type of situations.

Example Every detective is wondering whether it was Ann, Bill, or Carol.
(Judgment: *false*)

The judgment that this example is *false* makes sense if the distributive ignorance requirement takes scope under *every detective*. On the other hand, a global derivation of the pragmatic inference would predict the sentence to be *true*. Here's why: the predicted implicatures would be as follows:

(23) a. It is not the case that every detective wonders whether it was Ann or Bill.
b. It is not the case that every detective wonders whether it was Bill or Carol.
c. It is not the case that every detective wonders whether it was Carol or Ann.
and so on...

These implicatures are all *true* in the given situation. The presence of detectives 1 and 2 makes (23a) true. The presence of detectives 2 and 3 makes (23b) true. The presence of detectives 1 and 3 makes (23c) true.

The locality of distributive ignorance is a challenge for the pragmatic approach since pragmatic maxims are traditionally assumed to apply globally, i.e., to the sentence as a whole.[6] Certain apparently local implicatures have been explained within pragmatic approaches that are essentially Gricean in nature (see, e.g., Franke, 2009). It is possible that such pragmatic theories could ultimately derive local distributive ignorance implicatures with *wonder* as well. However, it is not immediately clear, to us, how this may be achieved.

We have seen, then, that a 'conservative' approach, which maintains C&R's semantics for *wonder* and tries to derive the distributive ignorance requirement pragmatically, encounters a number of challenges. However, this is of course not the only possible approach. Another option is to reconsider C&R's semantics of *wonder* and see if it could be adapted so as to derive the distributive ignorance requirement directly, without pragmatics. Clearly, such an approach would directly predict the obligatory and local nature of the distributive ignorance requirement. Moreover, it would steer clear of the non-monotonicity issue that the pragmatic approach faces. This is the route that we will take in the remainder of this paper.

[6]Locality also distinguishes *wonder* from other predicates, such as *believe*. Although *believe* also implies distributive ignorance when taking a referential subject, as illustrated in (i) below, examples with quantificational subjects reveal that this implication is not local, as illustrated in (ii) and (iii).

(i) John believes that it was Ann, Bill, or Carol. (implies distributive ignorance)
(ii) Exactly four detectives believe that it was Ann, Bill, or Carol. (*false* in (21))
(iii) Every detective believes that it was Ann, Bill, or Carol. (*true* in (22))

This contrast between *wonder* and *believe* suggests that distributive ignorance with *wonder* is a local implication associated with the semantics of the predicate itself while distributive ignorance with *believe* is a global pragmatic implicature that arises regardless of the embedding predicate.

5. Two semantic accounts

We will consider two ways to adapt C&R's semantics. The first (§5.1) directly strengthens the ignorance requirement in the lexical semantics of *wonder*. The second (§5.2) leaves C&R's basic entry for *wonder* intact, but additionally assumes that the semantics of the verb involves an *exhaustivity operator*, just like the semantics of *only*.[7] The main difference between these two accounts is that on the former, *wonder* remains sensitive only to the semantic content of the clause that it combines with, while on the second, due to the exhaustivity operator, it becomes sensitive to the formal structure of its complement clause as well. In §6 we will attempt to tease these two accounts apart based on data involving polar questions and *wh*-questions.

5.1. Directly encoding strong ignorance

In C&R's semantics of *wonder*, the ignorance condition is encoded as $\neg K_a\varphi$. That is, the subject's information state must not be contained in any alternative in $[\![\varphi]\!]$. This is a relatively weak notion of ignorance. A natural way to strengthen it would be to require that, in addition, the subject's information state should be compatible with every alternative in $[\![\varphi]\!]$. Let us introduce a new modal operator, I, which expresses this strong form of ignorance:

(24) $w \models I_a\varphi \iff \forall\alpha \in \textsc{alt}(\varphi) : \sigma_a(w) \not\subseteq \alpha$ and $\sigma_a(w) \cap \alpha \neq \varnothing$

Using this strong ignorance operator, we can then re-define the *wonder* modality in IEL:

(25) $W_a\varphi := I_a\varphi \wedge E_a\varphi$

This analysis directly encodes the distributive ignorance requirement in the lexical semantics of *wonder*. Clearly, the local and obligatory nature of the requirement are straightforwardly captured in this way.

5.2. Strong ignorance via exhaustivity

We now consider a more indirect account, which supplements C&R's entry for *wonder* with a built-in exhaustivity operator. We will assume that this exhaustivity operator is sensitive to the formal structure of the complement clause, rather than just its semantic content, because an account involving a purely semantic exhaustivity operator would be difficult to distinguish from the account specified above.

For any two natural language expressions φ and φ', we write $\varphi' \lesssim \varphi$ iff φ' is formally simpler

[7] Yet another possible analysis would be one involving an exhaustivity operator in the syntax (Chierchia et al., 2012) rather than in the lexical semantics of *wonder*. However, on such an approach additional assumptions would be needed about the distribution of this operator, in order to account for the locality and obligatory nature of the distributive ignorance requirement. For now, we leave this possible analysis out of consideration.

than φ in the sense of Katzir (2007), i.e., iff φ' can be obtained from φ by deleting constituents or replacing them with other constituents of the same syntactic category, taken either from the lexicon or from φ itself.

The exhaustivity operator that we will assume takes an expression φ and a set of formal alternatives A, and strengthens φ by negating every $\psi \in A$ that is not entailed by φ:

(26) $\mathbf{EXH}_A(\varphi) := \varphi \wedge \bigwedge\{\neg\psi \mid \psi \in A \text{ and } \varphi \not\models \psi\}$

Using this exhaustivity operator, the semantics of *wonder* can be formulated as follows:[8]

(27) $\ulcorner\text{wonder } Q\urcorner = \lambda x.\mathbf{EXH}_{\{W_x(\ulcorner Q'\urcorner) \mid Q' \lesssim Q\}}\, W_x(\ulcorner Q\urcorner)$

The formal alternatives for exhaustification are expressions of the form $W_x\ulcorner Q'\urcorner$, where Q' is grammatically simpler than the original complement Q. As a result of exhaustification, *x wonders Q* negates those formal alternatives that are not entailed by $W_x(\ulcorner Q\urcorner)$.[9] The obligatory and local nature of the distributive ignorance requirement follow from this analysis as well.

To see the account at work, consider the following sentence:

(28) Every detective wonders whether A, B or C.

For concreteness, let us assume that the complement in this sentence has the following structure (as far as we can see, all other reasonable assumptions about the structure of alternative questions are compatible with our argument as well):

(29) [whether [A or [B or C]]]

Further assume that *or* is translated as $\vee$ and that *whether* is semantically vacuous but syntactically requires at least one occurrence of *or* in its scope—if no such occurrence is overtly present, as in a polar question, there must be a covert *or not* (cf., Guerzoni and Sharvit, 2014; though again, other assumptions about the syntax-semantics interface of alternative questions would be compatible with our argument as well, as far as we can tell).

This structure can be simplified by eliminating either one or two of the disjuncts; in the latter case *whether* has to be eliminated as well. Such simplifications yield the following structures:

[8] Since the exhaustivity operator is structure-sensitive, our entry for *wonder* has to be syncategorematic.

[9] We could assume that formal alternatives are only negated if they are innocently excludable (IE), in order to avoid potential contradictions arising from exhaustification (Fox, 2007):

(i) $\mathbf{EXH}_A(\varphi) := \varphi \wedge \bigwedge\{\psi \mid \psi \in \mathbf{IE}(\varphi, A)\}$

(ii) $\mathbf{IE}(\varphi, A) := \bigcap\{A' \subseteq A \mid A' \text{ is a maximal subset of } A \text{ s.t.} \{\neg\varphi' | \varphi' \in A'\} \cup \{\varphi\} \text{ is consistent}\}$

However, we keep the simpler formulation in (26) since there would be no contradiction arising from the negation of non-weaker alternatives in the examples under consideration.

(30) [whether [A or B]] [whether [B or C]] [whether [A or C]] A B C

Thus, the sentence in (28) receives the interpretation in (32), which means that it is correctly predicted to be false in the scenario described in (22).[10]

(31) $\ulcorner$Every detective wonders whether A, B or $C\urcorner$

$$= \forall x : \textbf{detective}(x) \rightarrow \textbf{EXH}_{\{W_x(\ulcorner Q'\urcorner) \mid Q' \lesssim \text{whether } A,\, B \text{ or } C\}}\, W_x(A \vee B \vee C)$$

(32) $$= \forall x : \textbf{detective}(x) \rightarrow \begin{pmatrix} W_x(A \vee B \vee C) \\ \wedge \neg W_x(A \vee B) \\ \wedge \neg W_x(B \vee C) \\ \wedge \neg W_x(C \vee A) \\ \wedge \neg W_x(A) \\ \wedge \neg W_x(B) \\ \wedge \neg W_x(C) \end{pmatrix}$$

6. Teasing the two semantic accounts apart

We will now try to tease the two semantic accounts apart, by considering cases where *wonder* takes a polar question or a *wh*-question as its complement, rather than an alternative question. We will consider polar disjunctive questions like *whether-or-not Ann or Bill arrived* (§6.1), plain *wh*-questions like *which of the students arrived* (§6.2), ones where the domain of quantification is explicitly listed, as in *which of Ann, Bill, and Carol arrived* (§6.3), and ones where the domain specification involves a numeral, as in *which of John's three students arrived* (§6.4).[11]

6.1. Polar questions involving a disjunction

Distributive ignorance is observed also when *wonder* takes a polar disjunctive question complement, as in the following example:[12]

(33) John wonders whether-or-not Ann or Bill arrived.

That is, (33) implies that John is ignorant as to whether Ann arrived and as to whether Bill arrived. This is expected under the exhaustivity-based account, since the following complements are structurally simpler alternatives for the complement in (33):

[10] The last three conjuncts in (32) are tautologous, so they could in principle we left out. We do display them here just for transparency.

[11] We should note that the judgments reported in this section are based on introspection and discussion with a small number of native speakers. More systematic empirical work will be needed to obtain a more reliable picture of the relevant data.

[12] We use *whether-or-not* here, rather than just *whether*, in order to make sure that the complement is read as a polar question, and not as an alternative question. The relevant observation, however, applies just as well to complements headed by plain *whether*, interpreted as polar questions.

(34) a. whether-or-not Ann arrived.
b. whether-or-not Bill arrived.

Thus, (33) is predicted to imply, through exhaustivity, that $\neg W_j(A \vee \neg A)$ and $\neg W_j(B \vee \neg B)$. It follows from this that John must be ignorant as to whether Ann arrived. To see this, first suppose that John believes that Ann did arrive. This is incompatible with the basic ignorance requirement of (33). Now suppose that John believes that Ann did not arrive. Then, the basic ignorance and entertain conditions of (33) are satisfied only if John is wondering whether Bill arrived. But this is incompatible with the implication $\neg W_j(B \vee \neg B)$. So, John must be ignorant as to whether Ann arrived. Similarly, ignorance as to whether Bill arrived follows as well.

In contrast, on the direct account it is wrongly predicted that (33) may be true even if John already knows that Ann did not arrive, or similarly, if he already knows that Bill did not arrive.

6.2. Plain *wh*-questions

When *wonder* takes a plain *wh*-question as its complement, as in (35-37), the distributive ignorance requirement seems to be absent.

(35) *Situation: as in (11).*
John wonders which of his students arrived. (*true*)

(36) *Situation: as in (21).*
Exactly four detectives are wondering which of the suspects did it. (*false*)

(37) *Situation: as in (22).*
Every detective is wondering which of the suspects did it. (*true*)

If the distributive ignorance requirement were present in the same way as in our earlier examples involving alternative questions, (35) should be judged false, (36) true, and (37) false. The actual judgments, however, seem to be the opposite.

This contrast is expected under the view that the distributive ignorance requirement is a result of exhaustification w.r.t. structurally determined alternatives. After all, complements like *whether Ann or Bill arrived* count as structural alternatives for *whether Ann, Bill or Carol arrived*, but not for *which of his students arrived*. As a consequence, strong ignorance is predicted to arise with alternative questions but not with *wh*-questions.

On the other hand, the contrast is puzzling if the mechanism responsible for the distributive ignorance requirement is only sensitive to the semantic properties of the complement, as on the direct account. After all, it is hard to distinguish between alternative questions and *wh*-questions in terms of purely semantic properties.

One may attempt to derive the contrast on this approach from the assumption that *wh*-questions, unlike alternative questions, may involve *implicit domain restriction*. That is, (35-37) could be taken to involve the following implicit domain restrictions:

(38) John wonders which of his students [except Carol] arrived.

(39) Exactly four detectives are wondering which of the suspects
[that they are still suspecting] did it.

(40) Every detective is wondering which of the suspects
[that he is still suspecting] did it.

If this is indeed what is going on, the data is compatible with the direct account. For instance, it would then be predicted that (39) is false in the given scenario because all five detectives satisfy the distributive ignorance requirement with respect to the suspects that they are still suspecting. And similarly for the other examples.

However, on such an account it remains to be explained why the assumed implicit domain restrictions seem to be *obligatory*. Prima facie, one would expect that implicit domain restriction is optional, and that various restrictions would be possible, not just the ones explicated in (38-40). The case of (36)/(39) would be especially puzzling, because this sentence is judged *false* in the given context. Under the assumption that implicit domain restriction is optional, the Charity Principle would favor an interpretation *without* domain restriction in this case, because under such an interpretation the sentence would be *true* in the given scenario. However, the only interpretation that seems to be available is one on which the sentence is false.

6.3. *Wh*-questions with listed domain of quantification

Now consider the following variants of (35-37), where the quantificational domain is explicitly listed.

(41) *Situation: as in (35).*
John wonders which of Ann, Bill and Carol arrived. (*false*)

(42) *Situation: as in (36).*
Exactly four detectives are wondering which of Ann, Bill and Carol did it. (*true*)

(43) *Situation: as in (37).*
Every detective is wondering which of Ann, Bill and Carol did it. (*false*)

We see that 'list *wh*-questions' pattern with alternative questions rather than with plain *wh*-questions. This is again expected on the structure-sensitive exhaustivity-based account, because we have that *which of Ann and Bill arrived* $\lesssim$ *which of Ann, Bill and Carol arrived*.

Under the direct account, 'list *wh*-questions' are also expected to pattern with alternative questions under the assumption that they do not permit implicit domain restriction. This assumption seems quite natural, so the examples in (35-37) arguably do not present any new challenges for the direct account. However, as discussed above, it remains puzzling why plain *wh*-questions would obligatorily involve a specific kind of domain restriction.

An interesting hybrid between plain *wh*-questions and list *wh*-questions, as suggested to us by Brian Buccola, is the following:

(44) **Situation** A certain linguistics department has one full professor (Jones), three associate professors (A, B, and C), and three assistant professors (X, Y, and Z). Jones is a phonologist and has a question about semantics, which he thinks only a real semanticist could possibly answer. The only semanticists in the department are A and C (both associate professors).

Example Jones wonders which assistant or associate professor could answer his question. (*false*)

What is required for (44) to be true is that Jones considers at least one assistant professor and at least one associate professor possibly capable of answering his question (for instance, the sentence would be true if, in addition to A and C, Y were a semanticist as well). On the other hand, it is not required that Jones considers *all* assistant and associate professors possibly capable of doing so.

This is straightforwardly accounted for on the exhaustivity-based account, because we have that *which assistant professor* and *which associate professor* are structural alternatives for *which assistant or associate professor*. On the other hand, it is not so clear that the direct account could generate this prediction in a principled way. If we assume that implicit domain restriction is blocked in (44), just as in alternative questions and list *wh*-questions, then the predicted ignorance requirement would be too strong: Jones would have to be ignorant about all assistant and associate professors. If we assume that implicit domain restriction can apply freely, then the predicted ignorance requirement would be too weak: it would be predicted that the sentence is true even if Jones knows that none of the assistant professors are semanticists, as in the given context. So, some intermediate constraint on domain restriction would be needed, and it is not clear how such a constraint could be justified.

6.4. *Wh*-questions with numerical domain specification

Now consider the following variants of (35-37), where the domain of quantification is specified using a numeral. This has been argued in previous work to strongly disfavor, or even completely block, implicit domain restriction (Chemla, 2009; Geurts and van Tiel, 2016).

(45) *Situation: as in (35).*
John wonders which of his three students arrived. (*false*)

(46) *Situation: as in (36).*
Exactly four detectives are wondering which of the three suspects did it. (*true*)

(47) *Situation: as in (37).*
Every detective is wondering which of the three suspects did it. (*false*)

We see that 'numerical *wh*-questions' pattern like alternative questions and list *wh*-questions, and unlike plain *wh*-questions. This is predicted by the direct account, under the assumption that numerical *wh*-questions don't allow for implicit domain restriction, just like alternative questions and list *wh*-questions.

On the other hand, the contrast between numerical *wh*-questions and plain *wh*-questions is not immediately accounted for under the exhaustivity-based account, because the structural alternatives for numerical *wh*-questions do not include ones such as *whether Ann or Bill arrived*, which would be necessary to derive the distributive ignorance requirement from exhaustivity.

There is, however, a possible extension of the exhaustivity-based account formulated above, which does capture the contrast between numerical *wh*-questions and plain *wh*-questions. This extension incorporates a number of ideas from Chierchia's (2013) work on different types of indefinites (plain, NPI, free choice) and their interaction with exhaustification. We will briefly review these ideas and then return to the case of numerical *wh*-questions.

First, Chierchia assumes that indefinites and other quantifiers always come with a domain variable D, whose value is contextually determined. For instance, a sentence like *Some students arrived* is analyzed as $\exists x \in D.S(x) \wedge A(x)$, involving existential quantification over a contextually given domain D. This assumption is quite widespread, though not everyone agrees that implicit domains should be represented syntactically.

Second, Chierchia proposes that sentences involving a quantifier with domain variable D generate so-called *sub-domain alternatives*, which involve quantification over a subdomain $D' \subseteq D$. For instance, the sub-domain alternatives of *Some students arrived* are $\exists x \in D'.S(x) \wedge A(x)$, for any $D' \subseteq D$. Crucially for us, Chierchia proposes that these sub-domain alternatives can serve as input for exhaustivity operators, alongside structurally determined alternatives. Whether they actually play this role depends on whether they are *activated*. Chierchia proposes that the sub-domain alternatives generated by plain indefinites are only optionally activated. On the other hand, the sub-domain alternatives of specially marked indefinites (such as *any* and *ever*) are obligatorily activated, and therefore must always serve as input for an exhaustivity operator. This has certain interpretational consequences, and also accounts for the restricted distribution of such marked indefinites. For instance, the ungrammaticality of a sentence like *Any students arrived* is accounted for by the fact that exhaustification w.r.t. the sub-domain alternatives generated by *any* yields a contradiction in this case. On the other hand, in *John didn't expect any students*, exhaustification w.r.t. sub-domain alternatives does not yield a contradiction.

Now let us return to the contrast between plain *wh*-phrases (e.g., *which of his students*) and numerical *wh*-phrases (e.g., *which of his three students*). Extending Chierchia's ideas to *wh*-

phrases, it would be natural to assume that (i) *wh*-phrases always come with a domain variable and generate sub-domain alternatives, (ii) the sub-domain alternatives generated by plain *wh*-phrases are only optionally activated, but (iii) the sub-domain alternatives generated by specially marked *wh*-phrases, such as numerical ones, are obligatorily activated and therefore must serve as the input for an exhaustivity operator.

Given this, it is natural to assume that the exhaustivity operator in the lexical semantics of *wonder* is not only sensitive to structurally determined alternatives for the complement clause, but also to its sub-domain alternatives, when activated. Using $\text{SDA}(Q)$ to denote the set of activated sub-domain alternatives generated by Q, this can be implemented as follows:

(48) $$\ulcorner\text{wonder } Q\urcorner = \lambda x.\mathbf{EXH}_{\underbrace{\{W_x(\ulcorner Q'\urcorner) \mid Q' \lesssim Q\}}_{\text{structural alternatives}} \cup \underbrace{\{W_x(\varphi) \mid \varphi \in \text{SDA}(Q)\}}_{\text{sub-domain alternatives}}} W_x(\ulcorner Q\urcorner)$$

Under this treatment of *wonder*, we get exactly the desired predictions. For instance, (45) now implies, due to exhaustification w.r.t. sub-domain alternatives, that John is *not* wondering which of Ann and Bill arrived. This implication is false in the given context, so the sentence as a whole comes out false as well. And similarly for (46) and (47).

Thus, while the exhaustivity-based account needs to be further worked out and tested on a broader range of empirical data, it seems to be able to capture some interesting contrasts, and to have an advantage over the direct account in that it does not rely on particular constraints on implicit domain restriction which would seem difficult to motivate independently.

7. Conclusion

If an inquisitive predicate like *wonder* takes an alternative question as its complement, it implies that its subject is ignorant about each of the alternatives introduced by the question. This implication, which we call the distributive ignorance requirement, is not predicted by previous work on the semantics of *wonder*. Furthermore, a pragmatic approach to deriving distributive ignorance faces a number of challenges (non-monotonicity, obligatoriness, and locality). We thus considered two semantic accounts: one that directly encodes a strong form of ignorance in the meaning of *wonder* and the other based on a built-in exhaustivity operator.

To tease apart these two semantic accounts, we looked at four types of questions as the complement of *wonder*: polar questions involving a disjunction, plain *wh*-questions, *wh*-questions with a listed domain of quantification and *wh*-questions with a numerical domain specification. The fact that the distributive ignorance requirement is absent with 'plain' *wh*-questions but present with polar questions involving a disjunction and 'list' *wh*-questions suggests that the distributive ignorance requirement is sensitive to the structure of the complement. This is expected on the exhaustivity-based account, which comes with a structure-sensitive notion of alternatives (Katzir, 2007). Furthermore, although at first sight the presence of distributive ignorance with 'numerical' *wh*-questions seemed unexpected under the exhaustivity-based account, we proposed that it could be accounted for by incorporating exhaustification w.r.t.

sub-domain alternatives (Chierchia, 2013). On the other hand, in order to capture the contrasts between the different types of *wh*-questions, the 'direct' account would have to invoke particular constraints on implicit domain restriction. Given that such constraints seem difficult to motivate independently, we conclude that the exhaustivity-based approach is more promising.

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Hierarchical structure and local contexts[1]

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Abstract. We use antecedent-final conditionals to formulate a challenge to parsing-based theories of local contexts, and associated theories of presupposition projection and triviality, like the one given in Schlenker 2009. We show that a theory like Schlenker's predicts that the local context for the antecedent of an antecedent-final conditional will entail the negation of the conditional's consequent. It thus predicts that presuppositions triggered in the antecedent of antecedent-final conditionals will be filtered if the negation of the consequent entails the presupposition. But this is wrong: *John isn't in Paris, if he regrets being in France* intuitively presupposes that John is in France, contrary to this prediction. Likewise, parsing-based approaches to triviality predict that material entailed by the negation of the consequent will be felt to be redundant in the antecedent of the conditional. But this is wrong: *John isn't in Paris, if he's in France and Mary is with him* is intuitively felicitous, contrary to this prediction. Importantly, given that the material in question appears in sentence-final position in antecedent-final conditionals, both incremental (left-to-right) and symmetric versions of parsing-based theories of local contexts make the same problematic predictions here. In Mandelkern and Romoli 2017, we discuss one solution to this problem, given within a broadly parsing-based pragmatic approach. In this paper, we explore an alternate direction: incorporating attention to hierarchical structure into the calculation of local contexts. We sketch several possible implementations and point to some of the possibilities and challenges for a hierarchical approach to local contexts.

Keywords: presupposition projection, conditionals, parsing, linear order, hierarchical order, local contexts, triviality, incrementality.

1. Introduction

Schlenker (2008, 2009), building on previous observations by Soames (1989) and Heim (1990), questions the explanatory power of traditional dynamic approaches to presupposition projection, posing an explanatory challenge for any theory of presupposition projection as follows:

> **Explanatory Challenge for Presupposition Projection**:
> Find an algorithm that predicts how any operator transmits presuppositions once that operator's syntax and classical semantics have been specified.
> (Schlenker 2009)

This challenge has sparked a debate which has led to a variety of new theories, both static

[1]For invaluable discussion and feedback, we thank WooJin Chung, Danny Fox, Thony Gillies, Clemens Mayr, Eliot Michaelson, Daniel Rothschild, Philippe Schlenker, Florian Schwarz, Benjamin Spector, and Yasu Sudo; audiences at ENS, UCL, the University of Pennsylvania, and *Sinn und Bedeutung* 21; and several anonymous reviewers for *Sinn und Bedeutung* and *Semantics & Pragmatics*. This paper is a companion of Mandelkern and Romoli 2017, which explores the same puzzle but provides a different solution to it, and therefore shares some material in introducing the puzzle.

(Schlenker 2009; George 2008; Fox 2008, 2012; Chemla 2010) and dynamic (Chierchia 2009; Rothschild 2008, 2011).

One aspect of this debate is whether the algorithm for predicting presupposition projection should be based on parsing, a process which takes as input a string of linguistic items, and thus will be sensitive to the linear order of the elements of the sentence in question; or on the compositional calculation of meanings, a process which takes as input a syntactic structure, and thus is sensitive to the hierarchical structure of the sentence. This debate, in turn, bears on the more general question whether presupposition calculation should be thought of as a pragmatic post-compositional phenomenon, in the sense of Chierchia et al. 2012, or as part of compositional semantics, as in more traditional dynamic approaches like that of Heim 1983.

In this paper, we will explore antecedent-final conditionals. We will argue that antecedent-final conditionals with presupposition triggers in the antecedent present a challenge to parsing-based accounts of presupposition projection, as well as to theories of triviality that build on those accounts. We will focus in particular on the predictions of Schlenker (2009), who uses a parsing-based approach to reconstruct the notion of a local context, and then builds theories of presupposition projection and triviality on top of his theory of local contexts in a straightforward way.[2]

To briefly sketch the problem: the parsing-based approaches to presupposition projection which we will consider come in both symmetric and asymmetric versions. Both versions, however, predict that presuppositions triggered in the antecedent of antecedent-final conditionals will be filtered (i.e. will not project) if the negation of the consequent entails the presupposition. But this is the wrong prediction; for instance, (1) presupposes that John is in France, contrary to this prediction.

(1) John isn't in Paris, if he regrets being in France.

Likewise, parsing-based approaches to triviality predict that material entailed by the negation of the consequent of an antecedent-final conditional will be redundant in the antecedent of the conditional. But, again, this is wrong; for instance, (2) is felicitous, contrary to these predictions.

(2) John isn't in Paris, if he's in France and Mary is with him.

In Mandelkern and Romoli 2017, we lay out a solution to this problem which allows us to maintain a parsing-based pragmatic approach with the caveat that, in calculating local contexts, we take into account material presupposed by the surrounding strings; we show that, together with a semantics for the conditional on which the conditional presupposes the antecedent to be compatible with the context set, this approach avoids the present problem. This approach

[2] As we discuss in Mandelkern and Romoli 2017, however, the problems extend to other parsing-based accounts, including those which make use of a trivalent valuation instead of local contexts (e.g. Fox 2008, 2012) as well as pragmatic parsing-based theories like Schlenker 2008.

requires a substantial shift in the formulation of the symmetric algorithm for calculating local contexts, however.

In this paper, we will take these puzzles in a different direction. In particular, we explore whether these puzzles motivate an approach to local contexts which takes account of hierarchical structure, rather than linear order. We will discuss two ways this might go. The first derives local contexts from an algorithm much like Schlenker's, but which is built on hierarchical structures rather than strings. The second builds on more traditional approaches in dynamic semantics, augmenting these approaches with hierarchical constraints. Our discussion will be somewhat inconclusive: we believe that both approaches have merits which make them worth careful exploration, but both also face substantial challenges.

The remainder of the paper is organized as follows. In the rest of this introduction, we introduce Schlenker (2009)'s algorithm for computing local contexts. In Section 2, we lay out the problem for presupposition projection from antecedent-final conditionals, and in Section 3, the problem for triviality. In Section 4, we discuss our first pass at a hierarchical approach to local contexts, building on Schlenker's system. In Section 5, we discuss our second pass at a hierarchical approach, an attempt to incorporate attention to hierarchical structure into traditional dynamic systems. We conclude in Section 6.

1.1. A parsing-based theory of local contexts and presupposition projection

Schlenker (2009) addresses the explanatory challenge for presupposition projection by using a parsing-based algorithm to reconstruct the notion of a local context in a static, bivalent semantics.[3] In this section, we summarize Schlenker's theory of local contexts and presupposition projection; those familiar with the theory should skip to the next section.

The basic intuition motivating Schlenker, which is similar to the intuition motivating trivalent theories of presuppositions (Peters 1979; Beaver and Krahmer 2001; George 2008; Fox 2008, 2012), is that as we evaluate a sentence against some contextual information, we try to minimize our effort by evaluating the sentence only in those worlds of the context that "matter" for the evaluation. Further, we assume (at least initially) that the interpreter evaluates expressions of a sentence proceeding left-to-right. Before evaluating an expression, the interpreter will choose the smallest domain she needs to take into consideration in evaluating such expression. This smallest domain is the local context for the expression.

Thus, for example, as we evaluate a conditional like *If A then B_p* (where B_p is a sentence B which presupposes $[\![\mathsf{P}]\!]$), as we proceed left-to-right, we will evaluate the consequent only in those worlds of the context in which the antecedent is true.[4] This is because we know that in

[3]Schlenker's approach is parsing-based in the sense we gave above: its input is a string, rather than a syntactic structure. We remain neutral on the connection of a theory like his to theories of parsing in general.

[4]We use sans serif capital letters as sentence variables, and italics to set off a linguistic example in running text. We move freely between talking of presuppositions as sentences and as propositions. Where P is a linguistic item, $[\![\mathsf{P}]\!]^c$ is the meaning (intension) of P at context C (a non-empty set of possible worlds); we often omit reference to the context for readability. We use 'C' throughout to refer to the global context, and sometimes use 'C' as a

those worlds in which the antecedent is false, the sentence as a whole is true irrespective of the value of the consequent, and thus we can ignore those worlds (assuming here that *If ... then* expresses the material conditional; we revisit this assumption in Mandelkern and Romoli 2017). But we cannot ignore any worlds where $[\![\mathsf{A}]\!]$ is true, since we must check whether the consequent is true at those worlds to see whether the sentence as a whole is true. This means that the local context for B in *If A then* B_p is $C \cap [\![\mathsf{A}]\!]$.

We can then formulate a theory of presupposition in this framework as follows: we say that a sentence S is assertable in a context C only if, for every expression B_p in S, $[\![\mathsf{P}]\!]$ is entailed by B_p's local context in S. We then say that a sentence presupposes anything that is entailed by every context where it can be asserted. This means that the predicted presupposition of *If A then* B_p is $A \rightarrow P$: in other words, *If A then* B_p is assertable at C only if $A \rightarrow P$ holds at every world in C.[5] This approach correctly predicts that a sentence like (4) presupposes only the tautology that if John used to smoke he used to smoke:

(3) If John used to smoke, he stopped smoking.

But—as Schlenker (2008, 2009) and Chierchia (2009), building on Heim 1990; Soames 1979 and others, discuss—antecedent-final conditionals pose a problem for the asymmetry encoded in this algorithm. (4), like (3), appears to have only a trivial presupposition, but this is not predicted by the incremental left-to-right algorithm, which only considers material to the left of the presupposition trigger.

(4) John stopped smoking, if he used to.

Intuitively, we would like material on the right of the presupposition trigger to count in this case. In response to these data, Schlenker (2009) proposes a symmetric version of his algorithm, which works on the entire sentence, rather than proceeding left-to-right: it considers both material on the left and the right of the expression to be evaluated. The result is that the symmetric local context for B in a conditional with the form B_p*, if A* is $C \cap [\![\mathsf{A}]\!]$; thus we predict that a conditional like (4) has no presupposition, as desired.

Schlenker makes these intuitive ideas precise as follows. First, the incremental, left-to-right version:

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corresponding linguistic item whose intension is the global context.

[5] With $\rightarrow$ standing for the material conditional. Notice that for some cases, the predicted conditional presuppositions of conditionals appear too weak. This is the so-called Proviso Problem (Geurts 1996 and much subsequent work; see Schlenker 2011 among others for recent discussion). This problem is orthogonal to the one we discuss here, however. Although the problem we raise for presupposition projection, like the Proviso Problem, stems from a gap between the observed projection and what is predicted, there is a crucial structural difference: in Proviso cases, the gap is between observed presuppositions with the form $[\![\mathsf{P}]\!]$, and predicted presuppositions with the form $[\![\mathsf{A} \rightarrow \mathsf{P}]\!]$. It is possible that a principled story can be told about how we move from the latter to the former (and indeed just such a story has been told in the literature; see Mandelkern 2016 for citations and criticism). By contrast, in the cases we raise here, the gap is between observed presuppositions with the form $[\![\mathsf{P}]\!]$, and a predicted trivial presupposition—i.e. a presupposition of $\top$. It is much harder in this case to see how a strengthening story would help: there is no obvious principled way to get from $\top$ to $[\![\mathsf{P}]\!]$.

Definition 1.1. Local Contexts, Incremental Version:[6]
The *incremental local context* of expression E in syntactic environment $\mathsf{a\_b}$ and global context C is the strongest $[\![\mathsf{Y}]\!]$ s.t. for all sentences D and good finals b', $\mathsf{a}(\mathsf{Y} \wedge \mathsf{D})\mathsf{b}' \leftrightarrow_c \mathsf{aDb}'$.

In addition to this incremental algorithm, Schlenker (2009) also defines a symmetric version, which applies as a dispreferred rescue strategy:

Definition 1.2. Local Contexts, Symmetric Version:[7]
The *symmetric local context* of expression E in syntactic environment $\mathsf{a\_b}$ and global context C is the strongest $[\![\mathsf{Y}]\!]$ s.t. for all sentences D: $\mathbf{a}(\mathsf{Y} \wedge \mathsf{D})\mathbf{b} \leftrightarrow_c \mathbf{a}\mathsf{D}\mathbf{b}$, where **a** and **b** are derived from a and b by removing any presupposition material.

This symmetric algorithm is like the incremental version except for two features. First, it takes into account all material in the sentence, regardless of whether it precedes or follows the expression to be evaluated: this is what makes it symmetric. Second, it ignores presuppositions in the surrounding material. The reason for this second feature is that, as Rothschild (2008) and Beaver (2008) point out, without it, the symmetric algorithm incorrectly predicts that on a symmetric parse, presuppositions can cancel each other out. Thus we would predict e.g. that a sentence like (5), with the form A_p *and* B_p, should not presuppose p.

(5) The King of France is bald and the King of France is tall.

But this is wrong; to see that (5) presupposes that there is a king of France, note that this inference projects when (5) is embedded in the antecedent of a conditional, as in (6):

(6) If the King of France is bald and the King of France is tall, there will be no diplomatic incident.

Analogous data can be generated with disjunction (see Rothschild 2008). This problem is avoided by the algorithm given above, according to which we ignore the presuppositional material of a and b when calculating the local context of the constituent between a and b.

Notice that if we are evaluating an expression D which appears sentence-final, the symmetric and incremental local context of D are identical. This is important for our purposes: it follows that for the data we are concerned with in this paper—the antecedents of antecedent-final conditionals—the incremental and symmetric versions of the algorithm will make the same predictions.

[6] We restrict our attention here to a propositional fragment; for a general version, see Schlenker 2009. The good finals of an expression are all strings that can grammatically follow that expression. '$\leftrightarrow_C$' is material equivalence *modulo* a context C.

[7] This formulation assumes that it is possible to "delete" a sentence's presuppositions from the sentence. It is not obvious to us that this is possible, but we set aside this issue here. See Mandelkern and Romoli 2017 for further discussion.

2. The problem for presupposition projection

To work up to our puzzle, consider first a conditional with a presupposition trigger in the antecedent, as in (7).

(7) If A_p then B.

Here the incremental and symmetric algorithms for calculating local contexts make different predictions, since the trigger appears sentence-initial. The incremental algorithm predicts that (7) presupposes P. The symmetric one, on the other hand, takes into consideration the material following A_p in evaluating it. $[\![\mathsf{B}]\!]$-worlds would make the whole sentence true regardless of the value of the antecedent; thus we only need to consider $[\![\neg\mathsf{B}]\!]$-worlds in evaluating A_p.[8] In particular we must consider every $[\![\neg\mathsf{B}]\!]$-world in the context. Thus the symmetric local context of A_p in (7) is $C \cap [\![\neg\mathsf{B}]\!]$, and so the predicted presupposition of the symmetric algorithm is $\neg\mathsf{B} \rightarrow \mathsf{P}$.

Schlenker (2009); Chemla and Schlenker (2012) and Rothschild (2011) discuss whether the prediction of the symmetric algorithm for (7) is correct. But this discussion is complicated by the fact that the symmetric algorithm is taken to be a dispreferred interpretive strategy, making it hard to see how to evaluate this prediction.

We can avoid this complication, however, by considering the antecedent-final counterpart of (7), in (8).

(8) B, if A_p.

Here the incremental and the symmetric algorithms make the same predictions, since in both versions of the algorithm the material on the left of the trigger is taken into account, and there is no material to the right of the trigger in this case. This allows us to avoid difficult questions about the relation between an incremental and symmetric algorithm,[9] and directly evaluate the plausibility of a parsing-based algorithm of either form.

Both algorithms predict that at the point at which we process A, we only need to consider $[\![\neg\mathsf{B}]\!]$-worlds of C, because $[\![\mathsf{B}]\!]$-worlds would make the sentence true regardless of the value of the antecedent. Therefore the incremental and symmetric local context for A in (8) is $C \cap [\![\neg\mathsf{B}]\!]$. Thus the predicted presupposition of (8), for both the incremental and symmetric approach, is $\neg\mathsf{B} \rightarrow \mathsf{P}$.

But this prediction is problematic. It follows from this prediction that if the negation of the consequent of an antecedent-final conditional entails the presupposition of the antecedent, the sentence will be presuppositionless. Schematically, a case like (9), where $[\![\mathsf{P}^+]\!]$ entails $[\![\mathsf{P}]\!]$, is thus predicted to presuppose nothing.

[8] We sometimes use '$\neg$' and other logical connectives as abbreviations for the corresponding natural language conectives. We leave our derivations of local contexts at the present level of informality; the reader can check them for herself, or refer to Schlenker 2009.

[9] On which see Schlenker 2008, 2009; Chemla and Schlenker 2012 and Rothschild 2011.

(9) $\neg \mathsf{P}^{+}$, if A_p.

This prediction, however, does not match intuitions. To see this, consider first the conditionals in (10a), (11a), and (12a). They appear to presuppose that John is in France, that he is sick, and that he is a linguist, respectively, as predicted by the incremental parsing approach.

(10) a. If John regrets being in France, he isn't in Paris.
 b. John isn't in Paris, if he regrets being in France.

(11) a. If John's wife is happy that he is sick, he doesn't have cancer.
 b. John doesn't have cancer, if his wife is happy that he is sick.

(12) a. If John is happy he is a linguist, he isn't a semanticist.
 b. John isn't a semanticist, if he is happy that he is a linguist.

Consider now the corresponding antecedent-final conditionals in (10b), (11b), and (12b), which have the form of (9). Intuitively these have the same presuppositions as the antecedent-initial versions. The problem is that the symmetric and incremental versions of the algorithm both predict that (10b), (11b), and (12b) have no presuppositions.[10]

Both the symmetric and incremental parsing-based algorithms given in Schlenker 2009 thus apparently make the wrong predictions for antecedent-final conditionals with a presupposition trigger in the antecedent: they predict that, when the conditional has the form of (9), its presupposition will be filtered, whereas the presupposition in fact projects.

3. The problem with triviality

The parsing-based theory of local contexts can be straightforwardly extended to a theory which predicts when a sentence strikes us as trivial or redundant. We show in this section that the problem raised in the last section extends to this theory.

Reconstructing the notion of local context allows Schlenker (2009) to connect his theory to a general theory of triviality, a theory with roots in Stalnaker 1978 (see also Singh 2007; Fox 2008; Chierchia 2009; Mayr and Romoli 2016 among others).[11] Given the account of local contexts sketched above, we say that a sentence S is infelicitous if, for any part E of S, $[\![\mathsf{E}]\!]$ is entailed or contradicted by its local context.

This approach correctly predicts that a sentence like (13) should be infelicitous, since it has a part, namely *he is in France*, whose content is entailed in its local context (whether we calculate it incrementally or symmetrically):

[10]In other words, that all three have trivial presuppositions: respectively, that if John is in Paris, then he is in France; that if John has cancer, then he is sick; and that if John is a semanticist, then he is a linguist.

[11]A theory of triviality can also be formulated in terms of equivalence to simplifications of the sentence, in the sense of Katzir 2007, to which one can add an incremental component (see Mayr and Romoli 2016; Meyer 2013 and Katzir and Singh 2013 for discussion). The problems discussed here extend to this approach as well.

(13) #If John is in Paris, he is in France and Mary is with him.

Similarly, this approach predicts that (14) should not be assertable, given that *he is in Paris* is contradictory in its local context.

(14) #If John isn't in France, he is in Paris and Mary is with him.

So far so good. Now consider the predictions of the parsing-based algorithm for antecedent-final conditionals. Recall in particular that the local context of the antecedent of an antecedent-final conditional like B*, if* A is predicted by both the incremental and symmetric algorithms to be $C \cap [\![\neg\mathsf{B}]\!]$. The theory of triviality under discussion thus predicts that if $[\![\mathsf{A}]\!]$ is entailed or contradicted by $C \cap [\![\neg\mathsf{B}]\!]$, the sentence should not be assertable. Both the symmetric and incremental algorithms thus predict that a sentence with the form

(15) $\neg\mathsf{P}^{+}$, if P and Q.

will be infelicitous, since P will be redundant. But this is wrong. To see this, consider first the antecedent-initial conditionals in (16a) and (17a).

(16) a. If John is in France and Mary is with him, then he's not in Paris.
b. John isn't in Paris, if he is in France and Mary is with him.

(17) a. If John is sick and his wife is happy that he is sick, then he doesn't have cancer.
b. John doesn't have cancer, if he is sick and his wife is happy that he is sick.

We judge these conditionals to be perfectly felicitous. Now consider the antecedent-final versions, in (16b) and (17b). We judge these versions to be equally felicitous. However, the parsing-based theory of triviality (on both its incremental and symmetric versions) wrongly predicts that the antecedent-final versions will be infelicitous, since both have material that is locally redundant (*he is in France* and *he is sick*, respectively).

4. Hierarchical transparency

Antecedent-final conditionals thus present a puzzle for parsing-based approaches to local contexts. In Mandelkern and Romoli 2017, we present a solution to this puzzle which stays largely within the bounds of the parsing-based framework. Here we will explore two alternate solutions, both of which reject parsing-based approaches in favor of approaches which track hierarchical structure rather than linear order. As we will discuss, while both approaches show promise in relation to our data and others discussed below, both also face serious challenges that remain open at this stage.

The first solution, which we call a *hierarchical transparency* approach, retains the basic idea of Schlenker's algorithm: namely, that the local context for an expression in a certain environment is the strongest meaning which *adds nothing* to that environment; i.e. the strongest meaning which is *transparent* in that environment. Crucially, we depart from Schlenker, however, in implementing this idea with an algorithm that takes into account hierarchical structure, rather than linear order.

Before sketching the algorithm and how it might help with our case, let us quickly review some further data which will provide independent evidence for the hierarchical transparency approach. The first come from Ingason 2016, which explores triviality judgments regarding relative clauses in head-final languages, in particular Korean and Japanese. In brief, Ingason shows that triviality judgments track hierarchical structure, *not* linear order. To see the point, consider first the contrast between (18a) and (18b). (18a) is felicitous, while (18b) is infelicitous. This is just as predicted by the theory of triviality introduced above, since the local context for *is a man* will entail *is a man* in (18b), but not (18a).

(18) a. John met a man who is an uncle.
b. #John met an uncle who is a man.

These sentences are in English, a head-initial language, where hierarchical structure and linear order of relative clauses correspond. It turns out that when we look at head-final languages like Korean and Japanese, however, where hierarchical structure comes apart from linear order, judgments about triviality track hierarchical structure, *not* linear order. Here is Ingason's data from Korean:

(19) a. Mary-nun [[accesi-in] sengin namca-lul] mannassta.
Mary-TOP [[mister-ADN] adult male-ACC] met.
'Mary met an adult man who is a mister/uncle.'
b. #Mary-nun [[sengin namjcaa-in] acessi-lul] mannassta.
Mary-TOP [[adult male-ADN] mister-ACC] met.
'Mary met a mister/uncle who is an adult male.'

A theory of triviality based on linear order, like the one introduced above, will wrongly predict that (19b) is felicitous, since *uncle* cannot be part of the local context of *adult male*, as it follows *adult male* in the linear order of the sentence. By contrast to the predictions of a theory like that, these data seem to show that triviality judgments track hierarchical order in some sense, rather than linear order.

The second data point we will introduce here concerns presupposition projection, and comes from Chung 2017. Chung notes that Korean is a SOV language, and thus that the attitude verb generally follows its complement clause in terms of linear order. If the calculation of local contexts were sensitive to linear order, then, the local contexts for the complements of attitude verbs would be given by the global context, just as for unembedded material. But this is not what happens; presuppositions rather project just as they do in English, where the complement of an attitude verb follows the verb. For instance, (20) is not felt to presuppose that Mary used to smoke, contrary to what we would predict if the local context for the second attitude ascription was calculated based on linear order:

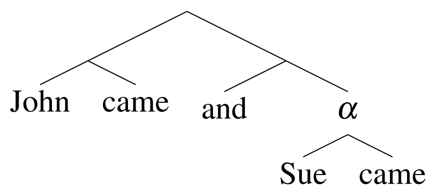
(20) John-un Mary-ka kotunghakkyo ttay tampay-lul pi-ess-ess-tako
John-TOP Mary-NOM high school time cigarette-ACC smoke-PERF?-PAST-COMP

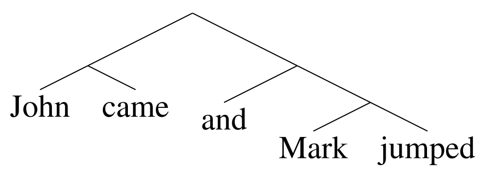
mit-ø-ko, (John-un) Mary-ka cikum-to keysokhayse tambay-lul
believe-PRES-CONJ John-TOP Mary-NOM now-also continuously cigarette-ACC
pi-n-tako mit-nun-ta.
smoke-PRES-COMP believe-PRES-DECL.
‘John believes that Mary smoked in high school, and he believes that she continues to smoke.’

This suggests that, just as in the case of triviality judgments, our calculation of local contexts needs to track hierarchical structure, not linear order. We will sketch an approach which modifies Schlenker’s algorithm so that it takes into account hierarchical structures, rather than linear order.[12] We will show how this kind of approach answers to the motivations just sketched, and then explore whether it also affords a solution to our puzzle from antecedent-final conditionals.

The idea is simple: to derive the local context for an expression, we look at that expression’s place in its LF, and we look at what we could add to that place in the LF, so that however the LF is completed, the LF’s denotation remains the same. There are different ways to flesh out what we mean by ‘however the LF is completed’. We will interpret this as meaning however we replace the material in that expression, or material which is structurally “below” it, in the sense of being asymmetrically c-commanded by it. This seems to us like a reasonable way of fleshing out the relevant notion, though it is worth noting that the basic idea could be implemented in a variety of other ways which are well worth exploring.

More formally, for any LF L and node α in L, let us define a *good-completion* of L at α as any well-formed LF which is identical to L except that any clause dominated or asymmetrically c-commanded by α may be replaced by new material.[13] For any sub-tree Y, let a *Y-good-completion* of L at α be any good completion of L at α such that α is replaced by a subtree beginning with *[Y [and _* . Thus for instance (22) is a good-completion of (21) at α, and (23) is a [John [came_-good-completion of (21) at α.

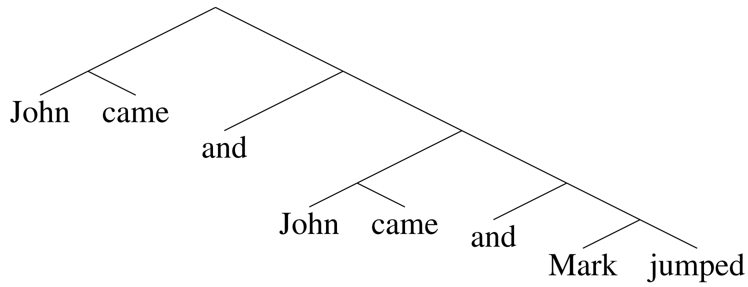
(21)


(22)


[12] We’ll focus only on the incremental version, since in the symmetric version, the predictions will be essentially equivalent to Schlenker’s approach.

[13] Why asymmetric c-command, instead of c-command? Consider an attitude ascription with the form *[John [believes [A]]]*. If we formulated our definition in terms of c-command, rather than asymmetric c-command, we would predict that in calculating the local context for A, we would have to ignore *believes*. This would yield the wrong results.

(23)

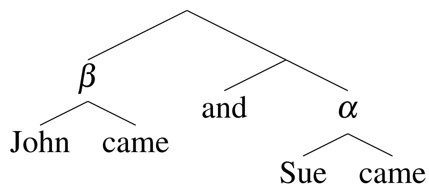


Now we are in a position to state the hierarchical transparency algorithm:[14]

Definition 4.1. Hierarchical Transparent Local Contexts:
The local context of expression E in LF L and global context C is the strongest $[\![Y]\!]$ s.t., where α is the lowest node which dominates a full clause containing E, for all good-completions D of L at α, and for all Y-good-completions D^Y of L at α, $[\![D]\!] \cap C = [\![D^Y]\!] \cap C$.[15]

The idea, again, is similar to Schlenker's algorithm, except that the local context here is calculated by finding the strongest thing that we can add to the LF of the expression in question while preserving contextual equivalence, *no matter how that LF is completed*—rather than the strongest thing we can add to the linguistic string, no matter how it is completed. Let's note, first of all, the overlap with Schlenker's algorithm. Assuming that conjunction has the straightforward hierarchical syntax illustrated in (21), then it is easy to verify that the local context for A in *A and B* in global context C is just C; and the local context for B is $C \cap [\![\mathsf{A}]\!]$. Thus for instance consider again (21), repeated here.

(21)



In calculating the local context for *John came*, we first find the lowest node dominating a full clause containing *John came*. We assume that this counts as a full clause itself, and so the lowest such node will be β. In considering good-completions at β, we can ignore everything below β (*John* and *came*), as well as everything β asymmetrically c-commands (*Sue*, *came*). Then the question will be: what is the strongest thing we can conjoin just below β such that it will not change the meaning of the whole LF, no matter how the rest is filled in? Since all we know about the rest of the LF is that it will have an *and* in it, the answer is clearly: the

[14] We assume now that our denotation function is defined on LFs.

[15] Why the reference to 'full clause'? Consider the question of what the local context for *John came* is in (21). Since *John came* asymmetrically c-commands *Sue came*, the latter will, correctly, be predicted not to be entailed by the local context of the former. But now consider what the local context for the first *came* is in (21). Since *came* does *not* asymmetrically c-command *Sue came*, then, if we did not have reference to a 'full clause' in our definition, we would wrongly predict that the local context for *came* does entail that Sue came. What a 'full clause' amounts to is something that of course needs to be spelled out precisely, but something we will remain vague about; we return to this briefly below.

global context. By contrast, in calculating the local context for *Sue came*, we will consider good-completions at α. Since α does not asymmetrically c-command anything in this LF, we will only look at good-completions that vary in the material α dominates, namely *Sue came*. What is the strongest thing that we can conjoin just under α that will be guaranteed to preserve the meaning of the LF? Clearly it is the conjunction of the global context with *John came*.

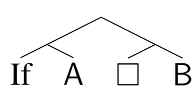
Likewise, the local context for A in *A or B* in global context C is just C; and the local context for B is $C \cap [\![\neg \mathsf{A}]\!]$. Likewise, finally, the local context for A in *Not A* in global context C is just C. These predictions are all identical to those of Schlenker's asymmetric algorithm (and, therefore, to the standard predictions of traditional dynamic theories).[16]

Things get more interesting, however, when we look at head-final or SOV languages like Korean. Assuming that the clausal part of the relative clause is asymmetrically c-commanded by its head noun, then, in our framework, the content of its head noun will always form part of the content of the local context for the relative clause, *whatever the relative linear order of the head and the relative clause*. That is, take a sentence like *John met an uncle who is a man*. We assume this sentence has an LF with a structure along the lines of *[John [met [an [uncle [who*$_1$ *[*t_1 *is a man]]]]]]*. In this structure, t_1 *is a man* does not c-command *an uncle*. This means that in calculating the local context for t_1 *is a man*, we will take into account *an uncle*, and thus we predict that the local context for t_1 *is a man* entails t_1 *is an uncle*, and therefore t_1 *is a man*. Crucially, in the hierarchical transparency account—unlike in Schlenker's parsing-based algorithm—this holds *whatever the linear order* of the relative clause and its head, provided that the hierarchical order is preserved. Similar considerations show that—since the complements of attitude predicates do not asymmetrically c-command the predicate—we predict that the local context under an attitude predicate is the set of attitude worlds, whether or not the attitude predicate precedes its complement, as in English, or follows it, as in Korean.

The hierarchical transparency approach to local contexts (or something roughly along these lines) seems to us to be the right way to preserve the explanatory and predictive virtues of Schlenker's algorithm, while respecting the fact that presupposition and triviality seem to be calculated in a way which depends on hierarchical structure, rather than linear order. But does it help with our problematic data involving antecedent-final conditionals? This depends crucially on the syntax of the conditional, both antecedent-initial and antecedent-final.

Start with antecedent-initial conditionals. We must suppose, first, that the antecedent asymmetrically c-commands the consequent; this would fall out, e.g., if the syntax of the conditional is roughly as in (24), where $\Box$ is the conditional's (possibly covert) modal.

(24)



[16]It is worth noting here that we can also capture symmetric filtering for connectives in this algorithm if we assume non-standard syntactic structure in those cases. We could, of course, also assume that a secondary, symmetric algorithm comes into play in those cases, as Schlenker does; but the present approach gives us flexibility to explore the possibility that there is only one algorithm, and that variations in syntax account for right-to-left filtering.

Second, we must suppose, crucially, that for the purpose of our algorithm, the largest 'full clause' containing A is the whole antecedent *If A*, not A on its own. This assumption is crucial to ensure that the consequent is ignored in calculating the local context for the antecedent; otherwise, in calculating the local context for A, we would not be able to ignore the consequent, since it is not asymmetrically c-commanded by A, and we would predict that the local context for the antecedent entails the negation of the consequent.

Given these assumptions, the local context for the antecedent *If A* will not entail the negation of the consequent, since the antecedent asymmetrically c-commands B, and so we will ignore that part of the LF in searching for the strongest transparent restriction for the antecedent. Instead, the strongest transparent restriction will just be the global context. By contrast, the consequent B does not asymmetrically c-command anything, and so we will ignore nothing when calculating the strongest transparent restriction for B, predicting that the local context is the global context intersected with $[\![\mathsf{A}]\!]$.

If we assume that antecedent-final conditionals are generated from the same LF as antecedent-initial conditionals, and simply linearized in a different way from antecedent-initial conditionals, this approach would make the correct predictions about the local contexts for the antecedents of both antecedent-initial and antecedent-final conditionals, thus solving our puzzle.

But this approach raises a number of serious questions. First, this approach assumes that the smallest 'full clause' that includes A in the sense relevant to our algorithm is *If A*, rather than just A; whereas the largest full clause containing B is B alone. It is not clear to us how to spell out these assumptions in a principled way. One way to do so would be to stipulate that the relevant notion is in part a semantic one, so that what counts as a full clause containing E in an LF L is the largest part of L whose denotation is equivalent to the smallest full clause containing E. Then, if we assume that *if* is semantically null (which would be natural in the kind of restrictor approach to the syntax of the conditional we are assuming here), it will fall out that the relevant clause to consider when evaluating the local context for A will be *If A*, rather than just A alone. By contrast, in evaluating the local context for B, we obviously will not take into account $\Box$, since $[\![\Box\mathsf{B}]\!]$ is certainly not the same as $[\![\mathsf{B}]\!]$. There is much more to explore as to whether these assumptions are plausible in other environments, and why things would work this way.

Second, there are binding data which suggest that antecedent-final conditionals are not generated from structures like (24). For instance, the infelicity of the co-indexed variant in (25) suggests that the the subject of the consequent of antecedent-final conditionals c-commands the subject of the antecedent, contrary to the picture we have assumed (see Bhatt and Pancheva 2006):

(25) He$_{[1*/2]}$ isn't at home, if John$_1$ is with Susie.

The plausibility of the hierarchical transparent approach will turn on whether appropriate syntactic assumptions can thus be fleshed out. This is a topic which we leave for future work. Let us note here, however, that, even if it does not solve the present problems, we might still opt for the hierarchical transparent approach on the basis of evidence of the kind discussed above, from Ingason (2016) and Chung (2017), and then supplement that approach with the solution to our problem given in Mandelkern and Romoli 2017.

5. Dynamic semantics

In this section we explore a second strategy for incorporating hierarchical structure into the calculation of local contexts, investigating how we could couple traditional dynamic semantics with a structure-based order constraint.

Traditional dynamic semantics along the lines of Heim 1983 avoids our problems from antecedent-final conditionals. This is because in such a system, as Chemla and Schlenker (2012) put it, the 'left-right asymmetries reach down to the lexical representations of logical operators.' And once the lexical meaning of a conditional operator is stipulated, it doesn't matter whether the antecedent appears sentence-finally or sentence-initially. In other words, given the way asymmetry is encoded in dynamic semantics, what matters is what is encountered first in semantic composition, rather than in linear order. And for both the antecedent-initial and antecedent-final cases, the denotation of *if* composes first with the antecedent and then with the consequent of the conditional. If *if* is treated as a (Curried) two-place sentential operator, as in Heim's system, once we define a context-change potential for *if* which makes the right predictions for an antecedent-initial conditional, it will make the same correct predictions for the antecedent-final counterpart.

This approach, however, fails to address the explanatory challenge summarized at the outset. We can briefly illustrate the problem as follows: there is nothing in the system that prevents us from defining a meaning for *if* which is (in a sense we can make precise) truth-conditionally equivalent to the one Heim proposes, but which makes the wrong predictions about presupposition projection for both antecedent-initial and antecedent-final conditionals. Heim's entry for the conditional is $c[\textit{If A, then B}] = c \setminus c[\mathsf{A}][\neg\mathsf{B}]$. A truth-conditionally equivalent entry would run $c[\textit{If A, then B}] = c \setminus c[\neg\mathsf{B}][\mathsf{A}]$. But this latter entry wrongly predicts that the negation of the consequent is taken into account in evaluating the presuppositions of the antecedent. The explanatory challenge for a theory like Heim's is how to rule out the latter entry in a principled way.

Constrained dynamic approaches (Rothschild 2008, 2011; Schlenker 2009; Chierchia 2009) aim to solve the explanatory problem by giving a principled way to determine CCPs for connectives. Rothschild (2008, 2011) in particular argues that the explanatory problem can be met by constraining possible CCPs according to their truth-conditional adequacy. While this does not uniquely yield a CCP for a given connective, it yields a limited range of CCPs. Rothschild then argues that this range represents admissible interpretations of a given connective. In order to account for an asymmetric bias in evaluating presuppositions, insofar as there is one, Rothschild proposes adding a (possibly defeasible) order constraint along the following lines: in determining the CCP for a formula $\psi * \varphi$, we do not allow any instance of the CCP for ψ to operate on a formula that contains φ.

A key question here is what is meant by a formula with the form $\psi * \varphi$: is the order of this schema meant to mirror linear order, or structural order? If the former, then Rothschild's system will fail to rule out the incorrect alternate CCP for the conditional just sketched. Indeed, Rothschild's system would make just the wrong prediction here: it would predict a strong, if perhaps defeasible, preference for that alternate CCP, where the negation of the consequent is entailed in the local context of the antecedent. A better option, then, is to interpret the order adverted to in Rothschild's order constraint in terms of hierarchical structure, rather than linear order. But it is tricky to spell out exactly how this is meant to go.

A natural first thought is that a sentence of natural language is mapped to $\psi * \varphi$, in the sense relevant for Rothschild's order constraint, just in case ψ asymmetrically c-commands φ. This would suffice to predict the ordinary asymmetric entries for conjunction and disjunction, since the first conjunct/disjunct asymmetrically c-commands the second, under standard syntactic assumptions; and it seems to capture Ingason's and Chung's data in a straightforward way. But does it help us? Only if both antecedent-initial and antecedent-final conditionals are such that the antecedent asymmetrically c-commands the consequent. This is the same assumption that we had to make in spelling out the hierarchical transparent approach in the last section. As we saw there, however, it is not obvious that this assumption is tenable in light of binding data from antecedent-final conditionals; much more work would have to be done to justify it.

A second approach would take the opposite tack: on this approach, a sentence of natural language is mapped to $\psi * \varphi$, in the sense relevant for Rothschild's order constraint, just in case φ asymmetrically c-commands ψ. If we go this way, then we need to say that the consequent of conditionals asymmetrically c-commands the antecedent in both antecedent-final and antecedent-initial conditionals. It is not clear to us whether this is plausible on general syntactic grounds. A simpler problem, however is that this approach yields the wrong results for conjunction and disjunction: since the first conjunct/disjunct asymmetrically c-commands the second, this approach will predict that the preferred interpretation of conjunction and disjunction will involve right-to-left filtering. While it seems to us open that the preferred interpretation of both conjunction and disjunction is symmetric, or that the preferred interpretation of both involves left-to-right filtering, it does not seem open to us that the preferred interpretation involves right-to-left filtering.[17] This approach also does not seem to account for Ingason's and Chung's data.

An alternative constraint, more semantic and less syntactic in spirit, builds on Chierchia (2009). The idea is to say that a sentence containing an operator $*$ gets mapped to $\psi * \varphi$ just in case $[\![*]\!]$ first takes $[\![\psi]\!]$ as an argument, yielding a function which then takes $[\![\varphi]\!]$ as an argument.[18] Now, if we assume that *if* denotes an operator which first combines with the meaning of the antecedent, yielding a new function which combines with the meaning of the consequent, then this way of mapping sentences into Rothschild's order constraint will ensure that the antecedent will always provide the local context for the consequent, but not vice versa, whether the antecedent is preposed or postposed, and whatever the underlying syntax turns out to be.

[17] Note that replacing 'asymmetrically c-commands' with 'c-commands' in either case does not help with the problems just sketched.

[18] This corresponds roughly to the relation Chierchia calls 'f-command'.

On first glance, the present approach faces the same objection as the last approach considered: again, if, as is standard, we assume that conjunction and disjunction denote functions which first combine with the right conjunct/disjunct, then this approach will wrongly predict exclusive right-to-left filtering for conjunction and disjunction.[19]

The present approach, however, unlike the last one considered, has a bit of room for maneuver in response to this issue. In particular, we can follow Chierchia (2009), who proposes a revisionary solution to this problem, based on two ingredients. First, we assume that conjunctions and disjunctions always contain either *both* or *either*, which can be overt or covert, and which, crucially, form a constituent with the first conjunct/disjunct, as in (26).

(26)

Second, the meaning of the two connectives is associated with *both* and *either*, respectively; *and* and *or* will be semantically vacuous. If we accept these two assumptions, the predictions of the hierarchical order account are now the expected ones: we will have left-to-right filtering for conjunction and disjunction, not right-to-left filtering. This is a substantial revisionary assumption about the syntax and semantics of connectives, however; the plausibility of this approach will depend on the plausibility of this assumption.

Another challenge for this solution is to explain cases of symmetric filtering with disjunction. A possible response would be to claim that a disjunction can involve an ambiguity as to whether the meaning of the connective is associated with *either* or it is associated with *or* when there is right-to-left filtering. The key question, again, is whether either structure is plausible on broader syntactic considerations.

A final challenge for this solution is whether it can be extended to account for the data we discussed in the last section involving triviality and presupposition projection in head-final and SOV languages. It is not at present clear to us how to do so.

6. Conclusion

We have used antecedent-final conditionals to formulate a problem for parsing-based theories of local contexts. Those theories—both in their incremental and the symmetric variants—predict that the negation of the consequent of antecedent-final conditionals will be entailed by the local context for the antecedent. Data from presupposition projection and triviality judgments, however, show that this is wrong.

In Mandelkern and Romoli 2017, we laid out one solution to this problem broadly within a parsing-based approach to local contexts. In this paper, we have explored two alternate solutions. The first builds on Schlenker's idea that a local context is the strongest trivial restriction in a given environment. Rather than taking the environment to be a linear string as Schlenker does, we explored an account which takes the environment to be an LF. The resulting theory

[19] See George 2008; Chierchia 2009 for discussion of this problem.

nicely accounts for a range of data which appear to show that the calculation of local contexts must be hierarchical. It helps with our problem only under certain assumptions about the syntax of the conditional, however—assumptions which raise a number of substantial questions which are beyond the scope of this paper.

The second solution builds on traditional dynamic semantic accounts along the lines of Heim 1983. As we discussed at the outset, this style of dynamic semantics has come under attack for being insufficiently explanatory. In recent years, however, more explanatory theories have been proposed which, like dynamic semantics, base the calculation of local contexts on compositional structure. We explored three ways in which hierarchical order could be used to constrain possible dynamic semantic entries according to the order of functional application. One way nicely accounts for Ingason's and Chung's data, but requires the same type of controversial assumption about the syntax of conditionals as the hierarchical transparency approach. The second and third approaches account for our data in a fairly straightforward way, but it is not clear they can account for Ingason's and Chung's data; and they face serious challenges in accounting for other connectives. We discussed a response on behalf of the third approach, based on Chierchia 2009, which avoids this objection by making certain revisionary assumptions about the syntax and semantics of other connectives—assumptions which, again, raise a number of substantial questions.

There have been various arguments in the recent literature that hierarchical order should play a direct role in the calculation of local contexts. It is not clear to us whether our data involving antecedent-final conditionals should be accounted for in this way, but, regardless of how those data are ultimately accounted for, we hope to have sketched several promising directions for incorporating hierarchical structure into the calculation of local contexts, along with some of the challenges those approaches face.

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A lexical marker of degrees of answerhood

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Abstract. Questions and their answers have been discussed at length over the past few years. In this paper we present and analyze a Hebrew hedger, *be-gadol*, roughly translated as *basically.* We use the literature on questions, answers and the relation between them to suggest that *be-gadol* is an item which conveys a restriction on the context of utterance. This restriction concerns the relation between answers to the QUD on an answerhood scale, which is characterized as involving two notions, informativity (Roberts 1996) and resolution, defined using tools from decision theories (Ginzburg 1995; van Rooij 2003). This significantly supports the linguistic reality of these notions.

Keywords: formal semantics, decision theory, decision problems, utility, resolution, answerhood.

1. Introduction

This paper deals with the Hebrew particle ***be-gadol***, which literally means *'in-big'*, and can be roughly translated as *in principle, by-and-large, in theory,* or *basically*. *Be-gadol* is a focus sensitive hedger/approximator which has a variety of uses and effects. The abundance of the effects leads to an empirical challenge, as it is very difficult to find a unified lexical entry which captures the variety of meanings of *be-gadol.* Moreover, we will argue that only some of the uses we find with *be-gadol* can be analyzed using existing tools. This leaves us in even deeper waters. Given the difficulties mentioned, the question at the center of this paper is how to account for all the data and all of these readings in a unified way, and which tools can be used for doing that.

The structure of the paper is as follows: This section will discuss some data to demonstrate the different uses of *be-gadol* and the next section will present our intuition. In section three we present the proposal in detail as well as apply it to several cases. We also review the theoretical tools needed for our purpose, in particular tools which deal with question resolution, informativity and utility (e.g. Roberts 1996, Ginzburg 1995, van Rooij 2003). In section four we examine an additional use of *be-gadol* which seems to pose a problem for our theory. We then propose a solution based on theories of projective meanings and relationships between questions under discussions and their answers (e.g. Simons et al 2010). Section five lays out some questions for further research, summarizes and concludes.

1.1. Data: The empirical challenge

As discussed above, using *be-gadol* can yield a variety of effects. For example, some of the uses we find with *be-gadol* can be paraphrased using other particles, as in (1) which we refer to as the "approximative" use, and as in (2) which we refer to as the "temporal" use. Both

(1a) and (2a) paraphrase the specific use of *be-gadol* in (1) and (2), and (1b) and (2b) give alternative paraphrases using a correlating particle (e.g. *more or less* and *for the most part*).

(1) ha-xeder be-gadol naki
the.room in.big clean
"The room is be-gadol clean."
a. The room is not completely clean
b. The room is more or less clean

(2) Context: John and Mary are talking about a party, John is inquiring about the mutual friend Rina's actions at that party.

John: What did Rina do at the party?
Mary: Rina be-gadol rakda
Rina in.big danced
"Rina be-gadol danced."
a. Rina danced most of the time
b. Rina danced for the most part

Crucially, however, there are also uses which cannot be paraphrased using such expressions. We will argue that uses like the ones in (3) and (4) cannot be analyzed using the tools which have been proposed for *for the most part* or *more or less.* For example, (3) is similar to example (2) but is used differently. We refer to (3) as the "significance" use. Another example can be found in (4), which we refer to as the "not enough details" use. (3a) and (4a) paraphrase the meaning of (3) and (4), but (3b,c), and (4b,c) demonstrate that unlike (1b) and (2b), paraphrases with *more or less* and *for the most part* are not available for the examples below.[1]

(3) Context: Rina sang, drank beer and spoke to the barman as she usually does in parties, but her dancing was her most significant, e.g. enthusiastic activity, attracting most of the attention. Dancing was not necessarily the longest activity, or atypical.

John: What did Rina do at the party?
Mary: She be-gadol danced
a. The most significant thing Rina did in the party was to dance
b. ≠for the most part she danced
c. ≠she more or less danced

(4) A: What do you do? What's your occupation?
B: ani be-gadol orex sfarim
I in.big edit books
"I'm be-gadol a book editor."

[1]Other interpretations of the same sentence are possible (e.g. paraphrases with *more or less*). However, they do not generate what we give in (3a) and (4a). The other available interpretations with the other particles correlate with the uses mentioned in (1) and (2). For example, one could say that *For the most part Rina danced* is a felicitous sentence, but instead of the meaning in (3a) we get the meaning that what Rina did during the party was mostly to dance.

a. What I do is more specific (e.g. I edit books dealing with medieval history and religion)
b. ≠for the most part I edit books
c. ≠I more or less edit books

As the examples above show, *be-gadol* can lead to a wide range of hedging effects, and not all of them can be paraphrased using other particles. The main challenge is to unify all these examples despite their differences. Due to the diversity of uses, the hedging effect cannot be analyzed by resorting to quantificational tools, as done for example by Nakanishi and Romero (2004) for *for the most part*, or just by using coarser granularities/lower precision standards, as Sauerland and Stateva (2007) suggest for *more or less.* The characterization of the hedging effect induced by *be-gadol* should be thus more general and flexible. To proceed along that direction we will present our intuition regarding the common denominator between the different uses and propose a semantics for *be-gadol*. We then continue by presenting the tools we need to proceed with the analysis, and justify our proposed semantics for *be-gadol*. The last piece of the puzzle is what seems like a counterexample and its solution, followed by a summary and a few open questions.

2. Intuition and proposal

We propose that in all the uses presented in section 1.1 *be-gadol* is a marker of degrees of answerhood to the QUD, which indicates a hedging effect along two dimensions: the propositional dimension and the discourse dimension.

On the propositional dimension the use of *be-gadol* indicates that the prejacent p is not the most informative answer to the QUD (cf. Roberts 1996). There is a better answer to the QUD, p_{best}. This p_{best} entails p and rejects an implied enrichment of p, q, which is stronger than p. For example, in (3) *she be-gadol danced*, p (*she danced*), is not the most informative answer to the QUD (*what did she do in the party?*). There is a better answer, p_{best}, *she danced most of the time and sang a little bit*, which entails p and rejects an implied enrichment of p, q, namely *she danced all of the time*, which entails p. We will claim that we cannot be satisfied with hedging solely along the propositional level, and that the hedging along the discourse level is central to the semantics of *be-gadol.*

On the discourse dimension, the use of *be-gadol* indicates that p is not the most helpful answer relative to the roles and goals of the participants in the discourse. The concept of roles and goals can be represented more concretely by resorting to the speaker's decision problem. For example, in (3) the question *What did Rina do in the party?* can be asked to learn about Rina's preferences, e.g. in a context where John wants to throw Rina a party and has to choose between different activities for the party. In this context John can inquire about Rina's preferences to resolve a decision problem regarding which party activities she might enjoy.

The better answer p_{best} is required to be the most helpful answer to the QUD given this decision problem, but p is still close to being the most helpful answer given this decision problem. For example, in (3) (*she be-gadol danced)* we suggest that any possible p_{best} (e.g. *she danced most of the time and sang a little bit*) is not only more informative than p, but also the most helpful answer relative to the roles and goals of the discourse participants in any possible context. In contrast, *she danced* is not the most helpful answer, but is nonetheless close to being most helpful. For example, *be-gadol* will be useful when for contextual purposes it is significant whether Rina danced all the time or did something else some of the time, because this fact might have consequences for the participants' decisions. The rejection of the strong enrichment that Rina danced all the time is helpful. Moreover, the fact that p is not the best answer but close to it emphasizes that the missing details of p_{best} may be relevant as well. We will illustrate all these notions with concrete examples below.

If this intuition is on the right track then the theoretical challenge at hand is how to capture 'degrees of answerhood' to the QUD, what exactly a *best* answer is, what makes p less good than p_{best}, and in what sense is p close to the best answer.

To answer these questions we will use the literature on resolving answers (e.g. Ginzburg 1995), and tools from decision theory (e.g. van Rooij 2003). In the following section we lay out our proposal and explain and illustrate the above intuition in further detail.

2.1. Proposal

As mentioned above, we suggest that the hedging operation with *be-gadol* results from the interaction between hedging along two levels – in the discourse level and the propositional level. In all its uses *be-gadol p* indicates that p is not the best answer to the QUD, and that a better answer (p_{best}) to the QUD is true. This better answer p_{best} is related to p in two ways:

First, p_{best} is related to p since we take p_{best} to be more informative than p. In particular we require that p_{best} entails p and at the same time rejects a strong (but implied) enrichment of p. Defining p_{best} in this way is the first component in our proposed lexical semantics for *be-gadol* which leads to the hedging effect on the propositional level.

Second, we take p to be a proposition which is not the best answer to the QUD, but which is still 'close' to such a best answer, p_{best}. The notion of a 'best' answer, and of being 'close' to a best answer, will be defined relative to a decision problem. This second component leads to the hedging on the discourse level.

Given these two components our proposal is found in (5).

(5) $||\textit{be-gadol}||_{w,dp} = \lambda p{\in}\text{QUD}.\ \lambda w{:}\ \exists q\ [q{\in}\text{QUD} \wedge p{\sim\sim>}q \wedge q{\subset}p \wedge \exists\text{BEST}{\neq}\emptyset$, where $\text{BEST} = \{p_{best}{\in}\text{QUD}{:}\ p_{best}{\subset}[p{\wedge}\neg q] \wedge \text{best}_{dp}(p_{best}) \wedge \text{Close}_{dp}(p_{best},p)\}]$.
$\exists p_{best}{\in}\text{BEST}\ [w{\in}p_{best}]$

In words, *be-gadol* (relative to w and a decision problem dp) combines with its prejacent, i.e. a proposition p which is a member of the QUD, and with a world w. It is defined if and only if there is a proposition q which is also a member of the QUD, which is stronger than (i.e. asymmetrically entails) p and is implied by it (i.e. it is a strong enrichment of p). In addition, there is a nonempty set, BEST, of propositions p_{best} which are also members of the QUD, such that for any p_{best} in this set BEST: p_{best} entails p and the negation of q (i.e. entails p and rejects its stronger enrichment), p_{best} is 'best' relative to the decision problem and p is 'close' to p_{best} relative to the decision problem.

Clearly, the notion of being a 'best' answer, and being 'close' to such a best answer, relative to the decision problem are the main novel parts of the definition. To explain these notions, and their necessary presence in the lexical entry of *be-gadol*, we will first consider in the following section the hedging effect of *be-gadol* along the propositional domain, i.e. the fact that some true answer, $p_{best,}$ is required to entail p and reject a strong (implied) enrichment of it. We then show that this hedging effect is not enough to account for the full range of facts concerning *be-gadol*. To get a fuller picture we characterize precisely the 'best' and 'close' components in the lexical entry in (5), which capture the hedging along the discourse domain, and demonstrate how adding these components account for the remaining data.

2.2. Illustrations and support

To try and account for the data by assuming hedging along the propositional dimension alone, consider the following examples. In every example (a) gives the prejacent, $p,$ (b) gives the strong enrichment of p, q, and (c) gives an example of a possible p_{best}. Example (6) includes the gradable adjective *clean.* We follow von Stechow (1984) in assuming that gradable adjectives denote relations between degrees and objects, and in the positive form as in (6a) a null morpheme *pos* introduces a standard degree, s.t. (6) is true iff the room is at least as clean as the standard (formally, $\exists d\ [d \geq stand_{clean} \wedge clean(the\ room,d)]$). Kennedy and McNally (2005) assume that the standard in adjectives like *clean* is maximal, although pragmatical shifts to lower standards are often used in actual context. Rotstein and Winter (2004), however, assume an interval of degrees in the maximal end of the scale, and hence semantically the standard is not always maximal. We follow Rotstein and Winter (2004) as well as McNally (2011), and Sassoon and Toledo (2011) in assuming that the standard for *cleanliness* can be identified with a point which is not exactly at the maximum of the scale.

(6) The room is be-gadol clean
  a. p: The room is clean
  b. q: The room is maximally clean
  c. p_{best}: The room is clean except for the windows

(7) Rina be-gadol danced
  a. p: Rina danced
  b. q: Rina danced all of the time (e.g. of the party)[2]
  c. p_{best}: Rina danced most of the time and sang a little bit.

(8) Mary is be-gadol a book editor
  a. p: Mary is a book editor
  b. q: Mary edits books in general.
  c. p_{best}: Mary is a book editor specializing only in medieval history and religion

[2]We think this implication is derived as a scalar implicature, namely that Rina's dancing eventuality was the only activity in the party. We don't go now into how precisely this is derived (e.g. how exhaustification scopes wrt the existential over events).

In all of these cases *be-gadol p* indeed indicates that a more informative answer, p_{best} (as in the (c) part of (6-8)) is true. This true answer indeed entails *p* (as in (a)) and rejects a stronger enrichment of it (as in (b)).

So far, everything seems to be working. However, as we said above, we require also that p_{best} be a 'best' answer to the QUD and that *p* be 'close' to it. To justify the two extra conditions on p_{best}, we turn to look at a case where hedging in the propositional level isn't enough, and using it alone yields over-generalization.

(9) Context: John is interested in arranging a birthday party for Rina and wants to have activities that she enjoys. He knows that Sarah and Rina went to a party last week. To be able to choose the activities that Rina will most enjoy in her birthday party, John wants to learn about her preferred party activities. For that purpose John is asking Sarah about Rina's behavior during the party. Sarah is aware of John's purpose. She saw that Rina danced most of the time of the party last week, sang for a little while, and spoke with the barman.

John: What did Rina do in last week's party?
a. Sarah: She be-gadol danced
b. Sarah: #She be-gadol danced and sang

(9a) and (9b) have correlating *p*'s, *q*'s and p_{best}*'s*, given in (10) and (11).

(10) Sarah: She be-gadol danced
a. p: she danced
b. q: she danced all the time
c. p_{best}: Rina danced and sang.

(11) Sarah: #She be-gadol danced and sang
a. p: Rina danced and sang
b. q: The only things she did in the party was to sing and dance.
c. p_{best}: Rina danced, sang, spoke with the barman.

In both cases there is a p_{best} which entails *p* and rejects a strong enrichment of it. Nonetheless, given the details of the context in (9), *be-gadol* is felicitous in (9a), and infelicitous in (9b).

To account for the infelicity of (9b), we propose the following intuition: *She be-gadol danced and sang* is odd because the information that Rina spoke with the barman does not seem to add anything relevant to what John is interested in. Thus, although a more informative answer is possible, e.g. the proposed p_{best} in (11c), it cannot count as a real appropriate 'best' answer. In fact, given John's goals, it is not better than the prejacent *She be-gadol danced and sang* – it does not add any relevant information.

Moreover, changing the goals of the participants in the discourse can affect the felicity of *be-gadol* in these examples. The answer in (12) is judged better in the following situation:

(12) Context: John suspects that Rina is a spy. He sends Sarah, a private detective, to follow Rina and report back to him. John and Sarah are talking as Sarah recounts Rina's actions during the party. Rina danced most of the time of the party, sang for a little while and spoke with the barman.

John: What did Rina do in last week's party?
Sarah: She be-gadol danced and sang

Intuitively, Sarah's answer is felicitous because the information that Rina spoke with the barman might be relevant under this context. That is, unlike what we saw in (9b), given these roles and goals of John and Sarah, *p* in (12) is really not the best answer anymore, so *be-gadol* achieves the hedging effect in the discourse domain. The conclusion from this is that characterizing the hedging effects of *be-gadol* using only informativity tools is not enough, and we need an additional type of hedging which is sensitive to the roles and goals of the participants in the discourse.

The observations we have made regarding *be-gadol* seem very similar to observations made in e.g. Ginzburg (1995) and van Rooij (2003) regarding answers to questions. Similarly to what we observed with *be-gadol*, these theories noted that for answers to be considered good answers, it is not enough that they are fully informative. Rather, they need to be also 'helpful' relative to the roles and goals of the participants in the discourse. Hence, we now turn to relevant details of these theories, so we can use the tools they developed to formally capture the complex hedging effect of *be-gadol*.

2.3. Hedging along the discourse domain

According to Ginzburg (1995), even if an answer is exhaustive (i.e. maximally informative), it is not always helpful (enough). In addition to that, a helpful answer can be non-exhaustive. Consider (13), inspired by example (15), on p.469 in Ginzburg (1995).

(13) Context: A scientist is invited to give a lecture at a university he's unfamiliar with. The scientist asks who will attend the talk, with the goal of giving a good and clear talk.

Question: Who is going to attend the talk?
a. Answer 1: (Provides an exhaustive list of names).
b. Answer 2: A number of cognitive phoneticians and Willshaw-net experts.

While (13a) is exhaustive, it is not helpful given the scientist's goal and information state. In contrast, (13b) is not exhaustive, but is helpful given A's and information state.

Van Rooij (2003) formalizes sensitivity to goals and information states using notions from probabilistic decision theory. A decision problem of an agent can be modeled as a triple <P,U,A>, where *P* is the agent's probability function which represents the agent's beliefs about the world, *U* is the utility function, which assigns each action a value, representing the agent's goals, and *A* is the set of alternative actions the agent considers. The expected utility (EU) of an action *a* in *A* is defined as in (14):

(14) $EU(a) = \Sigma_w P(w) \times U(a,w)$

In words, the expected utility of an action *a* is the result of the summing operation over worlds of the probability of being in each specific world *w*, times the utility value of the action *a* in that world.

To make the best choice between these actions the agent can ask a question. The answer to this question can help resolve the decision problem, i.e. help the agent calculate which action is the most likely to be most helpful. Given this calculation, the agent knows which is the action with the highest expected utility. Given an answer C, the maximal expected utility of the decision problem equals the maximal value of summing the conditional probability of each world given C, times the utility of each action *a*:

(15) $Max(\{\Sigma_w P_C(w) \times U(a,w): a \in A\})$

Given this, the agent can know which is the action with the highest expected utility (EU) given the answer C.[3]

Finally, for van Rooij, an answer which resolves the decision problem, a 'resolving answer', is one which leaves the agent with exactly one action with the highest EU.

With these theoretical tools at hand, we can now analyze the second component from our proposed lexical entry, the one where *be-gadol* hedges along the discourse domain.

Consider again our proposed lexical entry, repeated here as (16).

(16) $||\textit{be-gadol}||_{w,dp} = \lambda p \in QUD.\ \lambda w: \exists q\ [q \in QUD \wedge p {\sim\sim>} q \wedge q \subset p \wedge \exists BEST \neq \emptyset$, where
$BEST = \{p_{best} \in QUD: p_{best} \subset [p \wedge \neg q] \wedge best_{dp}(p_{best}) \wedge Close_{dp}(p_{best}, p)\}]$.
$\exists p_{best} \in BEST\ [w \in p_{best}]$

Above we suggested that the prejacent of *be-gadol, p,* is neither the most informative answer to the QUD, nor the most helpful, but still 'close' to being most helpful. This is captured in (16) by taking another answer, which we called p_{best}, to be the true answer to the QUD which entails *p* and rejects a stronger enrichment of *p*. In addition, p_{best} must be also best relative to the decision problem, and close to *p* relative to the decision problem.

We now define the notion of a best answer relative to the decision problem, and being 'close' to such a best answer more precisely, as in (17) and (18) respectively:

(17) p_{best} is the best answer relative to the decision problem iff
a. It is resolving, i.e. leaves us with exactly one action, which has a maximal EU[4]

[3]Benz (2006) and Benz and van Rooij (2007) have argued that a decision problem must also take into account information about the speaker in order to define "goodness" of answers.
[4]Formally, following ideas in van Rooij (2003), we require that $|\mathbf{p_{best, A^*}}| = \mathbf{1}$, where p_{best, A^*} is the set of propositions a*, of the form "you should choose action *a in A*", which are consistent with p_{best} ($p_{best} \cap a^* = \emptyset$). If the cardinality of this set is 1, then p_{best} is said to be 'resolving' – i.e. it leaves the agent with exactly one action: The one with the highest expected utility.

b. And any other distinct answer is either non-resolving, or leads to an equal or lower maximal EU:
$\forall s \in QUD\ [s \neq p_{best} \rightarrow [[\neg resolving(s)] \vee maxEU(P_{pbest},U,A) \geq maxEU(P_s,U,A)]]$, i.e. no other answer is <u>more</u> helpful, and leads to a higher maximal EU.

(18) p is 'close' to p_{best} iff
p is also resolving i.e. it also leaves the agent with single action, one with the highest EU, and $Small(maxEU(P_{pbest},U,A) - maxEU(P_p,U,A))$

To explain (18) in words, *p* is close to p_{best} iff the maximal EU of the action with the maximal EU that we are left with after learning *p,* is lower than the one we are left with after learning p_{best} but only slightly so. This boils down to a situation where the agent is a bit more certain (less at risk) that the action chosen is the right one after learning p_{best} than after learning *p.*[5] In this case, p_{best} leaves us with one action, with the highest EU, and *p* leaves us with one action, but with a slightly lower EU.

3. Illustration

Consider the example from (3), repeated here in more detail as (19). John asks Sarah a question, and Sarah, who is aware of the decision problem, answers with *be-gadol.*

(19) Context: John wants to throw a party for Rina, and plans an activity that she likes, out of the three potential activities in the following set of actions *A: {prepare a dancing activity, prepare a karaoke competition, prepare a jumping activity}.* John knows that Sarah and Rina participated in a party last week. To learn about what Rina likes to do in parties he asks Sarah, thinking that if Sarah tells him what Rina like to do he would know better which action to choose.

John: What did Rina do in last week's party?
a. Sarah: She be-gadol danced
b. Sarah: #She be-gadol danced and sang

The felicity of (a) and the infelicity of (b) hold, for example, in the following two scenarios:

(20) The 'temporal' scenario: Rina danced most of the time of the party, sang for a short while, and spoke with the barman.

(21) The 'significance' scenario: Rina danced most enthusiastically in the party, sang, as she usually does, and spoke with the barman. Dancing didn't occupy most of the time.

In both scenarios, we can find an answer, p_{best}, which meets the conditions in our definition, namely (22a) and (22b):

[5]There can be additional ways in which *p* can be 'close' to p_{best} (cf. van Rooij 2003). E.g., if *p* leaves us with more actions in the decision problem than p_{best} does, but not with many more. Alternatively, if given the decision problem our goal is just to gain more information, but *p* leaves us with less information than p_{best} does, but not with much less. We do not further discuss these options in the present paper.

(22) a. p_{best} for the temporal scenario: Rina danced most of the time and sang for a while.
b. p_{best} for the 'significance' scenario: Rina danced extremely enthusiastically and sang.

In both cases p_{best} is a true answer which entails *p* (*she danced*) and at the same time rejects a strong implication of it (*she danced all of the time*). Moreover, it is indeed the best answer with respect to the decision problem because learning it we can rather safely conclude that the dancing activity is the activity she will enjoy most. More formally, learning one of these p_{best} answers, we are indeed left with one action with the highest expected utility (i.e. the one which is most likely to be most helpful).

Assuming that this is p_{best}, Sarah's answer in (19a) (*She be-gadol danced*) is felicitous, since although the prejacent *She danced* is not the best answer, it is close to it. Despite the fact that like p_{best}, *p* also leads to choosing dancing as the activity for the party, the expected utility of this answer is a bit lower. Upon learning *She danced*, all John would know is that there was a dancing eventuality by Rina in the party. However, John will not know how long it lasted, whether it was significant or not, whether there were other relevant events which lasted more or were more significant, etc. Thus, learning that Rina danced in last week's party, John might choose the dancing competition for her party, but he will be less certain about whether this is the best choice to make. The EU of 'prepare a dancing activity' is still maximal compared to the other activities in the set, but lower given *p* than given p_{best}.

The infelicitous case in (19b) is discussed using the same context and decision problem as in (19). In this case, *She be-gadol danced and sang* seems odd since here *p*, namely *She danced and sang,* is not 'resolving': i.e. it leaves us with TWO possible actions (namely dancing and singing), and not one.

Moreover, if *p* does not end up less helpful than p_{best}, we get infelicity even when it IS resolving. To demonstrate this we will modify the context in (19) for the one in (23).

(23) Context: John wants to choose a pair of activities for the party, out of the following pairs: *{singing & dancing, dancing & jumping, singing & jumping}*. In reality, Rina danced for a long time, sang for a short while and spoke with the barman.

John: What did Rina do in last week's party?
Sarah: #She be-gadol danced and sang

Why is Sarah's answer odd in this case? After all, *p* (*She danced and sang*) leaves us with one action with the highest EU (namely choosing the pair 'dancing and singing' for the party). One way to think about this is that in this case there is no appropriate p_{best}. The more informative *She danced for a long time, sang for a while and spoke with the barman* cannot function here as p_{best} since, given John's goals it does not have a higher expected utility than *She danced and sang*. In other words, it is not more helpful, and hence, *be-gadol*'s required hedging in the discourse domain cannot be achieved.

To demonstrate the proposal further, we will consider two more cases, the 'not enough details' use in (24) and (25), and the 'approximative' use in (26) and (27).

(24) Context: John is having a sports event next week and wants to know whether to invite Danny (who is in general a good candidate for consideration). To decide on this matter John is asking about Danny. For example:

John: Is Danny healthy?
Mary: He is be-gadol healthy

In this case, we take *p, q* (the rejected strong enrichment of *p*), and p_{best} to be as in (25):

(25) a. p: Danny is healthy to a degree which is at least as high as the standard of health in the context.
b. q: Danny is healthy to a maximal degree
c. p_{best}: Danny is healthy except for a cold.

Learning *p* will encourage John to invite Danny. However, John will not be completely certain this is the right action to choose. Even given *p,* it is still possible that Danny is not maximally healthy. If this is the case, and given that John doesn't know what keeps Danny from being completely healthy, John may be worried that participating in the competition will not be good for him. However, given p_{best}, John will be in a better position to decide exactly what to do. No matter whether John decides to invite Danny or not, John will now be more certain about making the right call, and hence the expected utility (EU) of the action with the maximal EU given p_{best} will be higher than the maximal EU given *p.*

(26) Context: Mary is looking to hire employees for her new publishing house, where most books deal with history, sociology, etc. Mary thinks we may want to interview Danny.

Mary: What does Danny do? What's his profession?
John: He is be-gadol a book editor (I'm not sure exactly which type of books he edits)

In this case, we take *p, q* (the rejected strong enrichment of *p*), and p_{best} to be as in (27):

(27) a. p: Danny is a book editor
b. q: Danny can edit all types of books (i.e. he doesn't specialize in any specific field)
c. p_{best}: Danny edits history books

As before, after learning *p* Mary will probably tend to interview Danny. However, Mary will not be completely certain this is the right action to choose, since it is possible that Danny specializes in editing a type of books which is not relevant for the publishing house. Even so, it may be still helpful to interview Danny. Learning p_{best} Mary would be in a better position to decide exactly what to do, and to decide whether to interview Danny or not. Mary would then be more certain of the chosen action. Here too the EU of the action with the maximal EU given p_{best} is a higher given p_{best} than it is given *p.*

4. An apparent counterexample and a suggestion for a solution

As mentioned above in section 1.1, *be-gadol* also yields a use which seems to pose a problem for our theory. An example is (28).

(28) Context: Danny tried to get into medical school. To do that one has to pass an exam. The passing grade for the exam is strictly 80 and, generally, if you pass you get accepted. Mary wants to know whether to congratulate Danny or not. She asks Sarah about his current situation.

a. Mary: Well, what about Danny? Did he pass the exam?
b. Sarah: be-gadol hu avar, aval hayu yoter miday muamadim tovim
in.big he passed, but were too many candidates good
"Be-gadol he passed, but there were too many good candidates."

According to the analysis we proposed above, *be-gadol p* is felicitous iff *p* is not the best answer to the QUD, i.e. not most informative, and not most helpful. This is so because there is another answer, p_{best} which IS the most informative and helpful answer.

The problem in (28b) is *be-gadol* is felicitous although its prejacent seems to be already the best answer: Most informative (i.e. does not imply some enrichment *q* which is negated by p_{best}), and also most helpful, since Mary is left with one action (i.e. congratulate Danny), with the highest EU.

We suggest that this kind of example can be nonetheless covered by our proposal for *be-gadol.* To explain this we use an independently motivated mechanism proposed in Simons et al (2010), which has been proposed in the literature regarding the connection between projective meanings and questions under discussion.

Simons et al (2010) suggest that what is projected is 'not at issue', where such 'not at issue' material is often, but not always, a presupposition. Projection of presupposition can be blocked when the content is at-issue relative to the QUD, i.e. is relevant to determine which of the answers is true.

However, they bring some examples where it seems that at issue content is nonetheless projected. Consider (29) below, a slight variation of the original example in Simons et al., which is odd without its context.

(29) Context: Chloe is writing invitations for her birthday party to kids in her class. Her mother notices that all of the invitations are to girls.

a. Mother: Are there any boys in your class?
b. Chloe: I don't like the boys in my class.

The direct answer to the mother's question is that there are boys in Chloe's class, and hence this answer constitutes at issue content. Importantly, this content is projected in Chloe's answer. Simons et al. (2010) claim that this is not a counterexample for their generalization that content does not project when at-issue. The claim they make is that (29b) is not an answer to the mother's explicit question, but rather to a broader QUD. Put in other words, the immediate QUD is stated explicitly in (29a), but there is also an implicit question, namely, *Why aren't you inviting any of the boys in your class to your party?* Making the accommodation of this broader implicit question would explain what is going on in the sequence in (29). Given this broader question the sequence is felicitous since "there are boys in my class" is not at issue with respect to this implicit broader question, and hence is projected in (29b).

Considering the shift from the immediate QUD to a broader QUD, the example in (28) with *be-gadol,* can be reconsidered. Although the explicit question asked by Mary is *Did Danny pass?* this is just a subquestion of a broader, implicit question *Did Danny get into medical school?* Interpreting the answer in (28b) as an answer to the broader QUD, *p* is once again a not-best answer, as required by our theory. The best answer to the broad QUD would be an answer along the lines of *Danny passed the test but didn't get accepted,* as demonstrated in (30).

(30) Rina: Danny be-gadol passed, but there were too many good candidates.
  a. p: Danny passed, i.e., he most likely got accepted, but maybe not.
  b. q: Danny got accepted.
  c. p_{best}: Danny passed but didn't get accepted.

In the context of the broader implicit QUD, if Mary wants to decide whether she should congratulate Danny or not on his acceptance to medical school, (30a) would not resolve this decision problem in the best way, since given p_{best} Mary will be more certain in her decision (namely not to congratulate Danny). In addition, as required, the best resolving answer (30c) negates the strong implication *q* (30b) of *p* (30a). Despite not being the best answer, *p*, namely *he passed*, is still 'close' to being such a best answer, since its EU is just a bit lower than that of p_{best}. This is because passing the exam almost always leads to getting accepted, so learning *p* Mary is close to being certain that she chooses the best answer (in this case, that she can congratulate Danny).

Also worth mentioning is the fact that this case is the only one where it is necessary to continue the *be-gadol* sentence with ***but*** (e.g. *but there were too many candidates*). *But* creates here a strong counterexpectational effect (see e.g. the QUD-based analysis of *but* in Toosarvandani 2014).

One possible explanation for this is that this is the only case where p_{best} must leave us with the opposite action (e.g. not congratulate Danny) than the one we are left with after learning *p* (congratulate Danny). However, the precise nature of the relation between *but* and *be-gadol,* as well as other interesting interactions / parallels between the hedging operation of *be-gadol* and the semantics of *but* still await further inspection.

To conclude, we call this use the "change your question" use of *be-gadol.* For this use to be available *p* should be the complete answer to the immediate QUD (e.g. *Did he pass?*). To allow the hedging effect on the propositional level there must be a higher, super-QUD in the context (e.g. *Did he get accepted*?), or such a question must be available for accommodation. (see also Büring 2003, Simons et al 2010 on other constructions where such accommodation is necessary).

5. Summary and open questions

We looked at a range of hedging effects exhibited by *be-gadol*, which cannot be easily reduced to a single operation. To account for the full range of data in a unified way we suggested that *be-gadol* lexicalizes a hedging operation over answers to questions. It indicates that p is not the best answer to the QUD, and that there is a better answer, p_{best}, which is true.

Crucially, the hedging operation is done on two levels. First, the propositional level where p_{best} is more informative than p, since it entails p and rejects a strong enrichment of it. Second, the discourse level, where p_{best} is more 'helpful' than p given the goals and information state of the participants (though p is 'close' to being most helpful). This aspect of *be-gadol* can be captured by resorting to notions from the literature on resolving answers, and using formal tools from decision theory. To the extent the analysis is on the right track, it supports the linguistic reality of these notions of tools in a new way.

There are several open questions that still need to be accounted for and directions to check. For example, we are still checking whether the analysis will work for all examples with *be-gadol,* across contexts and decision problems, whether there are other/better ways to define what 'the best answer' to the QUD is. In addition, perhaps there are also other possibilities to make p 'close' to p_{best}, e.g. by ending up with more, but not many more actions after learning p than after learning p_{best}.

Furthermore, we aim to explore whether there are other members of this 'discourse hedgers' family. Are there more hedgers that are sensitive to how helpful their prejacent is relative to the goals of the participants? Potential candidates for such hedgers are *theoretically / in theory / in principle / by and large / basically…*etc. If these are indeed members of the same family, it would be highly significant to define their core semantics and characterize the parametric differences between them.

Maybe the most central issue to understand is the reasons for which a cooperative speaker would use *be-gadol* at all. If the speakers knows the best answer to the question, why use *be-gadol p,* and indicate that p is NOT the best answer? Perhaps what *be-gadol* actually does is signal that while its prejacent p is the best answer to the immediate decision problem, there is a 'higher', more elaborated decision problem which still needs to be resolved. If this is so, we need to develop a model with hierarchies of decision problems, similarly to hierarchies of QUDs (cf. Roberts 1996, Büring 2003 on Contrastive Topics). We leave this issue for further research.

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Picture Descriptions and Centered Content[1]

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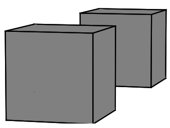
Abstract. There is an argument based on sentences that describe pictures in favor of a viewpoint-centered possible worlds semantics for pictures, over a propositional semantics (J. Ross 1997). The argument involves perspectival lexical items such as “front”. We show that when a projective possible worlds semantics for pictures is employed, there is a problem with the argument coming from propositional contents being strong. The argument is reconstructed in a model modal space involving linear worlds, and it is shown that it works there, by computing the possible worlds semantics. The construction involves propositions and centered propositions that are regular sets of strings. Finally, by manipulating the marking parameter in a projective semantics for pictures, the argument is reconstructed also for 3D models.

Keywords: Semantics of pictures, linguistic descriptions of pictures, centered possible worlds.

1. Introduction

Some recent work on the semantics and pragmatics of pictures and pictorial narratives has used a framework where these artifacts, just like sentences, have propositional semantic values that are constructed as sets of possible worlds or possible situations (Greenberg 2011, 2013; Abusch 2012, 2014, 2016). We use Scott brackets for both kinds of semantic values. Just as (1a) designates the semantic value of the sentence inside the brackets, (1b) designates the semantic value of the picture inside the brackets.

(1) a. ⟦there are two cubes⟧
b. ⟦  ⟧

There are advantages in assuming information contents for pictures and linguistic phrases in the same semantic space. One comes in the analysis of multimodal messages consisting of a picture and sentence, where one wants to combine information from the two media into a whole. Another comes in the semantic analysis of sentences such as (2) that describe pictures. Ross (1997) gave a compositional semantic analysis of such sentences in terms of the propositional semantic value of the mentioned picture, and the propositional semantic value of the prejacent clause beginning with *there*.

(2) In the picture, there is a cube next to an octahedron.

[1]For comments and assistance, we thank audiences at SuB and McGill, Luis Alonso-Ovalle, Mark Steedman, Michael Wagner, and Ede Zimmermann.

Ross then pointed out a problem for this propositional theory having to do with sentences describing pictures where the prejacent clause includes perspectival constructions such as "in front of", as in (3).

(3) In the picture, there is a cube in front of an octahedron.

Ross addressed the problem by replacing propositional semantic values for pictures and for the prejacent sentence with *viewpoint-centered* semantic values. These are analagous to the agent-centered semantic values in Lewis's *de se* analysis of attitude semantics (Lewis 1979). The point of this paper is to construct Ross's argument using the semantic assumptions summarized in the next section, refute it, and then reconstruct it by modifying the semantic framework.

2. Ordinary and centered pictorial contents

Classic and modern treatises on perspective, and contemporary works on computer graphics, describe mathematical recipes for mapping a three-dimensional worlds to pictures (Szeliski, 2010). We proceed here by indentifying three-dimensional worlds with data structures that specify the location, scale, and orientation of geometric objects. (4) is a world with two cubes, and nothing else.

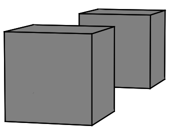
(4) Possible world w_1

type	*scale*	*translation*	*rotation*
cube	1.0	[0,0,0]	[0,0,0]
cube	1.0	[3,0,0]	[0,0,0]

Given in addition a specification of a viewpoint (a certain kind of oriented location) and a "marking rule", a picture is mathematically determined. The viewpoint has information that determines a family of oriented projection lines and a planar region (corresponding to the picture) in the three-dimensional space. A marking rule determines how points in the picture region are to be colored. Rule R_1 combined with w_1 and a certain viewpoint results in picture (6).

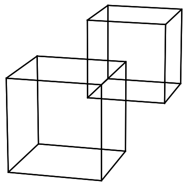
(5) R_1 : Mark a point in the picture plane black if the projection line from the viewpoint through that point intersects the edge of an object before it intersects any other part of an object, otherwise in gray if it intersects some object, and otherwise in white.

(6)

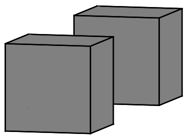


(7) describes the marking rule for a "line drawing", resulting in pictures such as (8).

(7) R_2: Mark a point of the picture plane in black if the directed projection line intersects the edge of an object, and otherwise in white.

(8) 

Finally, projection lines can be determined in various ways with respect to the viewpoint. Using parallel projection lines instead of lines intersecting at the viewpoint results in an orthographic picture such as (9). Call the projection line parameter G.

(9) 

Summing this framework up, there is a parameterized procedure that determines a picture p from a world w in a space of geometrically constructed worlds $\mathscr{M}$, a viewpoint v, a marking rule R, and a projection-line parameter G. This is summarized in (10).

(10) $p = \Pi(\mathscr{M}, w, v, R, G)$

Starting from a picture p and a fixed $\mathscr{M}$, R and G, a semantic value as a set of worlds is now obtained by inverting projection in the way defined in (11). The semantic value of p is the set of worlds w such that using R and G, w projects to p from some viewpoint.

(11) $[\![p]\!]^{\mathscr{M},R,G} = \{w | \exists v. p = \Pi(\mathscr{M}, w, v, R, G)\}$

Alternatively, instead of existentially quantifying the viewpoint, the semantic value of a picture can be defined as a set of world-viewpoint pairs. This is a set of viewpoint-centered worlds, analogous to the believer-centered worlds discussed by Lewis (1979). The viewpoint-centered semantic value is defined in (12).

(12) $[\![p]\!]^{\mathscr{M},R,G}_{\triangle} = \{\langle w, v\rangle | p = \Pi(\mathscr{M}, w, v, R, G)\}$

3. Picture descriptions and Ross's argument

The analysis in Ross (1997) uses the formalization (13b) for sentence (13a). The operator $[x]$ is a modal necessity operator based on the propositional content of x. The formula $[x]\phi$ is true if and only if for every world w in the propositional content of x, formula ϕ is true in w.

(13) a. In one picture, there is a man on a couch.

b. $\exists x.\mathbf{picture}(x) \wedge [x]\exists y \exists z[\mathbf{man}(y) \wedge \mathbf{couch}(z) \wedge \mathbf{on}(y,z)]$

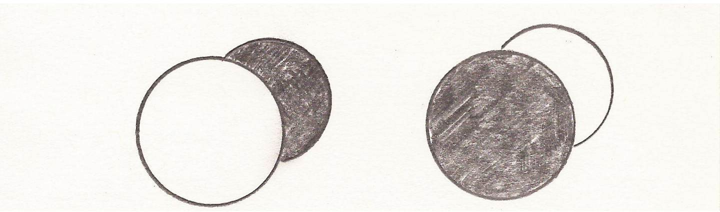
This semantics for picture descriptions is isomorphic to the subset semantics for belief descriptions. Sentence (13a) is true in a world w_0 if and only if there is an x s.t. x is a picture in w_0, and for all worlds w in $[\![x]\!]^{\mathscr{M},R,G,w_0}$, there is a y and a z such that y is a man in w, z is a couch in w, and y is on z in w. A nice aspect of the analysis that it uses the general propositional semantics for the prejacent sentence *there is a man on the couch* in (13a). There is no need to refer to a semantics for the prejacent sentence that is specific to the pictorial medium.

Ross's argument for centered contents has to do with the truth or falsity of sentence (14), construed as referring either to the picture on the left in (15), or the picture on the right. Intuitively the sentence is true with reference to the picture on the left (Picture 1), and false with reference to the picture on the right (Picture 2).

Suppose the pictures have identical propositional semantic values, along the lines of "there is a white ball and a black ball". We can't get different truth values for the sentences in (16), because the pictures enter into the subset semantics for the in-the-picture construction via their propositional semantic values.

(14) In the picture, there is a white ball in front of a black ball.

(15)



(16) a. In Picture 1, there is a white ball in front of a black ball.
b. In Picture 2, there is a white ball in front of a black ball.

What goes wrong? Ross pointed out that the problem comes up when the prejacent sentence contains an element such as *in front of*, the semantics of which is sensitive to a perspective. Note that the sentences in (17), where there is no perspectival lexical item, are not problematic like the sentences in (16), because they do have the same truth value.

(17) a. In Picture 1, there is a white ball next to a black ball.
b. In Picture 2, there is a white ball next to a black ball.

This can be related to an independently motivated perspectival parameter in the semantics of *in front of*. Suppose Keisha uses sentence (18a) to tell Justin where his bike is. The information conveyed is similar to what is conveyed by (18b), but stronger in that Justin gets the information that the bike rack is between the oak and the route, not simply near the oak. This motivates the hypothesis that *in front of* includes a covert perspectival parameter—it is understood as *in front from a perspective on the route*.

(18) a. On the route to school, there is bike rack in front of a big oak. The bike is locked there.
b. On the route to school, there is bike rack next to a big oak. The bike is locked there.

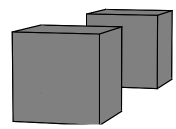
This kind analysis of *in front of* is well motivated, and there is substantial literature on it (Kemmerer, 2006; Kelleher and van Genabith, 2006). Ross used it in a solution to the puzzle of the balls. The first step is to use a viewpoint-centered semantics for pictures, as introduced in Section 2. The second step is to hypothesize that the construction in-x-ϕ binds the viewpoint parameter of the prejacent sentence ϕ. The result is that both the picture x and the prejacent ϕ contribute viewpoint-centered propositions. The semantics for in-x-ϕ does the subset check for these viewpoint-centered propositions, rather than ordinary propositions as before.

(19) Semantics for [in x, ϕ]
For all $\langle w, v \rangle$ in $[\![x]\!]^{\mathscr{M},R,G,w_0,g}$, $[\![\phi]\!]^{w,g[v0 \mapsto v]} = 1$.

Notice now that the two pictures in (15) have different viewpoint-centered contents. In centered worlds $\langle w, v \rangle$ in the content of Picture 1, there is a white sphere and that is closer to the viewpoint than a black sphere. The reverse is true of centered worlds in the content of Picture 2.

4. A problem with strong pictorial contents

We want to ultimately agree with the argument summarized in Section 3, and with the conclusion. However, there is a problem. Ross assumes that pictures 1 and 2 have identical propositional contents. The same assumption is made in subsequent literature (Blumson, 2010). However, this runs afoul of the fact that pictorial contents as obtained in the projective theory are in some respects strong. For instance, the propositional content of the picture in (20a) is stronger than the propositional content of the sentence in (20b). This is shown by the fact that the possible world w_2 given in (21) is in the content of the sentence, but not in the content of the picture. In w_2, there are two cubes, so (20b) is true. But there are no edges from different cubes that are parallel. In worlds consistent with picture (20a), there are two cubes with pairs of parallel and indeed co-linear edges, assuming perspectival projection. In general, any picture of two cubes gives information about the orientation of the cubes, and there is no picture that entails sentence (20b) and has no additional entailments.

(20) a. 

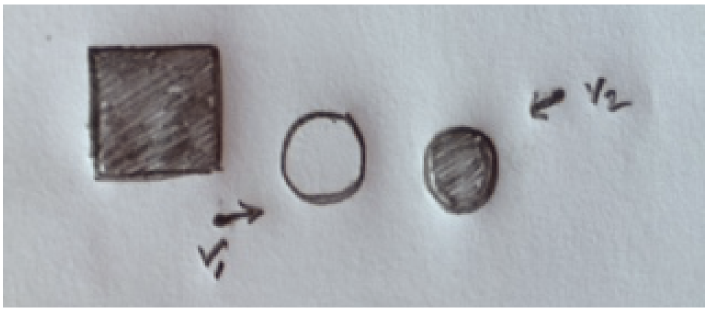
b. There are two cubes.

(21) Possible world w_2

type	*scale*	*translation*	*rotation*
cube	1.0	[0,0,0]	[0,0,0]
cube	1.0	[3,0,0]	[1,1,1]

In the same way, the content of the pictures 1 and 2 in (15) is stronger than the proposition that there is a black sphere and a white sphere. One additional entailment in this case is that there are no *other* objects visible from particular viewpoints. Consider a world w_3 with exactly three objects, which are a white sphere, a black sphere, and a black cube. The three are in line, with the white sphere in the middle. See (22).

(22) World w_3:



From the viewpoint v_1, the cube is not in view, and and $\Pi(\mathscr{M}, w_3, v_1, R, G)$ is p_1. However, from v_2, the black cube is in view in the background, and $\Pi(\mathscr{M}, w_3, v_1, R, G)$ is not p_2. In fact, there is no viewpoint v such that $\Pi(\mathscr{M}, w_3, v, R, G)$ is the picture p_2. Since the propositional denotation of p_2 is $\{w | \exists v \Pi(\mathscr{M}, w_3, v, M, G) = p_2\}$, w_3 is not an element of $[\![p_2]\!]^{\mathscr{M},R,G}$. The propositional denotation of p_1 is $\{w | \exists v \Pi(\mathscr{M}, w_3, v, R, G) = p_1\}$, and v_1 is a witness for w_3 being an element of $[\![p_1]\!]^{\mathscr{M},R,G}$. So contrary to what the argument from Section 3 has to assume, p_1 and p_2 do not have the same propositional contents, if propositional contents are defined by geometric projection as described in Section 2.

5. Pictures and projection in lineland

In this section we construct a family of models where Ross's argument does work, because pictures have weak contents that in a certain sense have no extra information. The worlds are "linelands"—worlds that have the form of a string. An additional feature is that the semantics is computable, because the propositions that are the denotations of sentences are regular sets of strings. These are the sets of strings that are representable by regular expressions and by finite state machines.

To illustrate, world s_1 as defined in (23) is a world with (from the left) a ruby, an opal, a picture of a ruby in front of an opal, two opals, and finally a ruby. A "ruby" is the character `r`, and an "opal" is the character `y`. Pictures are delimited by brackets, with a square bracket marking the front of a picture, and round bracket marking the back. Within a picture, the character `b` depicts a ruby, and the character `w` depicts an opal. Thinking of `b` and `w` as black and white, these are black and white pictures. The assumptions are listed in (24).

(23) World s_1

`_r_y_[bw)_y_y_r_`

(24)

`r`	ruby
`y`	opal
square bracket	front of picture
round bracket	back of picture
`b`	ruby in picture
`w`	opal in picture

The underlined positions seen in (23) are reserved for discourse referents, which are used for compositional semantics. The ultimate discourse referent `1` is used for the most recently mentioned object, and the discourse referent `2` for the penultimately mentioned object. The indexed world in (25) has an ultimate discourse referent for a picture, because `1` immediately precedes the start of a picture. And it has a penultimate discourse referent for a ruby, because `2` immediately precedes `r`.

(25) World s_2
`2r_y1[bbw)_r_y_r_y_`

Let *SitD* be the set of all indexed situations of this kind, and let *Sit* be the set of all situations without discourse referents. They are defined by terms in an extended language of regular expressions. *Sit* is a set of strings, used as the set of all worlds. Regular subsets of *Sit* are used as propositions, and regular subsets of *SitD* are used as information states in a dynamic semantics. Semantic composition is performed mainly using relation composition, using the relations listed in (26). *New* is the random choice operator of dynamic semantics. *Forget* deletes discourse referents to map to a proposition. The remaining operators are tests. *Ruby* checks that there is a ruby at the ultimate discourse referent, i.e. that `r` follows `1` in the string.

(26)

New	introduce random discourse referent 1, while demoting 1 to 2.
Forget	delete discourse referents
Ruby	check that 1 is an ruby
Opal	check that 1 is an opal
Pict	check that 1 is a picture
Adj	check that 1 is adjacent to 2

In these terms, the proposition denoted by (27a) is defined by (27b). The circle indicates relation composition, or restriction of a relation to a domain or co-domain. R^{co} is the co-domain of relation R. In combination with *Forget*, it is used to map to a proposition. The dynamic semantics works by inserting 1 in a random location; checking that the object marked by 1 is an opal; inserting 1 in a random location while demoting 2 to 1; checking that the object marked by 1 is a ruby; checking that the objects marked by 1 and 2 are adjacent; and finally forgetting the discourse referents.

(27) a. There is a ruby adjacent to an opal.
b. $[Sit \circ New \circ Opal \circ New \circ Ruby \circ Adj \circ Forget]^{co}$

These above sets and relations are defined in a language of extended regular expressions. Complete definitions are found in the replication supplement (Rooth and Abusch, 2017). The definitions can be interpreted computationally, using Xfst or Foma (Beesley and Karttunen, 2003; Hulden, 2009), to obtain a computational representation of a propositions such as (27b).

The next issue is the encoding of centered propositions. A center or viewpoint is modeled with the character ">" or "<", located in the block where discourse referents are also placed. A centered world has exactly one center. Examples are in (28)-(29).

(28) Centered world c_1, with a center looking towards a ruby in front of an opal.
`r_y_[bbw)_r_y>r_y_`

(29) Centered world c_2, with a center looking towards an opal in front of a ruby.
`r_y_[bbw)_r_y<r_y_`

(30) describes relations that randomly insert a center and delete a center. The basic relation *Front* requires that both 1 and 2 are in the direction indicated by the center, with 1 encountered first.[2]

(30)

NewC	randomly insert a center
ForgetC	delete the center
Front	the center is `>`, `>` precedes `1`, and `1` immediately precedes `2`, or the center is `<`, `2` immediately precedes `1`, and `1` precedes `<`.

The semantics of (31a) is defined in (31b), without deleting the drefs or the center. (31c) gives a sample of the centered indexed worlds in the centered proposition.

(31) a. There is a ruby in front of an opal.
b. $[\mathit{Sit} \circ \mathit{NewC} \circ \mathit{New} \circ \mathit{Opal} \circ \mathit{New} \circ \mathit{Ruby} \circ \mathit{Front}]^{co}$
c.
```
>[wb)1r2y_r_r_r_r_y_r_r_y_r_
_(bww]>r_y_r_r1r2y_
2y1r_[bb)<y_r_r_y_
>[bw)1r2y_
_r>(bwwwbbww]_y_y_r_y1r2y_y_
2y1r<y_r_[wb)_y_r_y_y_y_r_r_y_y_
>(wbwbbwb]_y_y1r2y_r_
2y1r<[bwbww)_r_r_
>[wb)1r2y_r_
```

A semantics for pictures is defined in the form of an accessibility relation. Starting from an indexed world s with a picture at dref 1, this is done by non-deterministically constructing a world that is consistent with the content of the picture. Transformations are made incrementally,

[2]This defines *Front* as *immediately in front*. It could be defined the other way.

using substitution and deletion relations. The steps are given in (32).[3]

(32)
a. Delete everything outside the picture at dref 1, retaining the dref marker.
b. Optionally reverse the picture at dref 1.
c. If the picture is left-oriented, non-deterministically insert any element of *Sit>Sit* to the left of the dref marker 1, and non-deterministically insert any element of *Sit* to the right of the picture marked by 1.
d. If the picture is right-oriented, non-deterministically insert any element of *Sit*<*Sit* to the right of the picture marked by 1, and non-deterministically insert any element of *Sit* to the left of the dref marker 1.
e. Substitute "y" for "`w`", and "`r`" for "`b`", in the picture following 1, while deleting the brackets for that picture.
f. Delete the dref marker 1.

Each transformation is definable as a regular relation, except for the reversal. These relations are composed to define the accessibility relation $P_\triangle$. Steps c-d preserve oriention, with the center in the output pointing towards the former location of the front of the picture. In order to include reversal, the length of pictures that are reversed has to be bounded.[4] $P_\triangle$ is the composition of the six component relations. The centered semantic value of the picture at dref 1 in a world is obtained as an image, see (33).

(33) The centered semantic value of the picture at discourse referent 1 in indexed world s is $[s \circ P_\triangle]^{CO}$.

While this construction does not explicitly employ projection, it is natural as a version of projective semantics. Since the worlds are one-dimensional, the projection procedure should look at a zero-dimensional object, that is a point. This indicates that a "projection line" corresponds to a distance in front of the viewpoint, determining a point in the world, the properties of which are checked to determine the picture.[5]

A propositional acquaintance relation P is obtained by composing $P_\triangle$ with a relation that deletes the center, see (34), and a propositional semantic value is obtained as the image of P, see (35).

(34) $P \overset{\text{def}}{=} P_\triangle \circ \mathit{ForgetC}$

(35) The propositional semantic value of the picture at discourse referent 1 in indexed world s is $[s \circ P]^{CO}$.

We return now to Ross's argument. The picture at dref 1 in world p_1 given in (36a) is a picture

[3] See the definition of Pt (corresponding to $P_\triangle$) in the supplement.

[4] Possibly this can be finessed, depending on how accessibility is to be used. The finite state calculus includes reversal as an operation, but reversal of a string is not a regular relation. In the code, only pictures of length three or less are reversed.

[5] We have not looked into developing this in the finite state construction.

of two rubies in front of an opal. The corresponding centered semantic value is (36b). This is a certain countably infinite set, which includes the worlds listed in (36c).

(36) a. World p_1

```
_ r _ y 1 [b b w) _ r _ y _ r _ y _
```

b. $[p_1 \circ P_\triangle]^{CO}$

c.

```
_ (b w w w w] > r _ r _ y _ [b b) _
> r _ r _ y _ y _ [b b) _ [w b b) _
> (b w w w b b] _ r _ r _ y _ r _
_ (b b b b w] _ y _ r _ r _ [w b) <
_ (w b] _ (w b] _ [b b) _ y _ r _ r <
_ y _ r _ r < r _ (w b] _ (w w w] _
```

The picture at dref 1 in the world p_2 given in (37a) is a picture of an opal in front of two rubies. The corresponding centered semantic value is (37b). This is a certain countably infinite set, which includes the worlds listed in (37c).

(37) a. World p_2

```
_ r _ y 1 [w b b) _ r _ y _ r _ y _
```

b. $[p_2 \circ P_\triangle]^{CO}$

c.

```
_ y > (w b] _ y _ r _ r _ (b w b] _
_ (w b b] > y _ r _ r _ y _ (w w] _
> (w b w b w w] _ r _ y _ r _ r _
_ r _ r _ y _ [w b) _ [b b) < (w b] _
_ r _ r _ y < [w w w) _ [w w b b) _
_ r _ r _ r _ y _ [b w) < [b b w) _
```

The centered semantic values are different if and only if at least one of the set differences $[p_1 \circ P_\triangle]^{CO} - [p_2 \circ P_\triangle]^{CO}$ and $[p_2 \circ P_\triangle]^{CO} - [p_1 \circ P_\triangle]^{CO}$ is non-empty. Given the explicit computable semantics, this can be checked computationally. Both differences are non-empty. (38) lists some worlds in the content of the first picture but not the second. (39) lists some worlds in the content of the second picture but not the first. So the centered contents of the two pictures are different, as required in the argument.

(38)

```
_ y _ r _ r _ r _ [w w w w) < r _
> (w w] _ r _ r _ y _ [w b) _ [w w) _
_ r _ y _ [b w b w) > r _ r _ y _
_ y _ r _ r _ [b b w) _ [b w) _ r <
_ [w w) _ (w w] _ y _ r _ r < [b b) _
_ y _ r _ r _ [w w b b b b b b) <
```

(39)
```
_ r _ r _ y _ [b b b) _ (b b b b] <
_ [b b b) _ r _ r _ r _ y _ [w w) <
_ (b b b w] _ r _ r _ y _ (b w b] <
_ r > y _ r _ r _ (b b w] _ (b w] _
_ r _ r _ y _ [b b b b) _ (w b b] <
> y _ y _ r _ r _ (w b] _ [w w b) _
```

By the way, while the centered contents are different, they are not disjoint. (40) lists some worlds in the semantic conjunction of the two pictures.

(40)
```
_ [w w b) > y _ r _ r _ y _ (b w] _
> y _ y _ r _ r _ y _ (w w w w] _
_ [b b) _ y _ r _ r _ y _ (w b b] <
_ [w b w w b w) > y _ r _ r _ y _
_ [w b b) _ y _ r _ r _ y _ (w b] <
_ (b w b w] > r _ r _ y _ r _ r _
```

Second we evaluate the set differences $[p_1 \circ P]^{CO} - [p_2 \circ P]^{CO}$ and $[p_2 \circ P]^{CO} - [p_1 \circ P]^{CO}$ computationally. Both terms evaluate to the empty set, indicating that the propositional contents are the same. This is what failed in Section 4.

Finally, consider truth value of sentence (41a) in world p_1. We assume the pronoun picks up the center, marked by the dref marker 1. We are using a dynamic semantics, with the prejacent sentence formalized as in (41b). To check the truth value, we check whether any centered worlds are lost in moving from the centered proposition denoted by the picture to that proposition updated with the prejacent sentence. The original proposition is (42a), and the updated proposition is (42b). When these are compared computationally using a set difference, we find that no worlds are lost in the update; this indicates that (41a) is true in p_1. When the same experiment is done with p_2, worlds are lost, and sentence (41a) is false in p_2.

(41) a. In it, there is a ruby in front of an opal.
b. There is a ruby in front of an opal.
c. $[\mathit{NewC} \circ \mathit{New} \circ \mathit{Opal} \circ \mathit{New} \circ \mathit{Ruby} \circ \mathit{Front} \circ \mathit{Forget}]^{CO}$

(42) a. $[p_1 \circ P_{\triangle}]^{CO}$
b. $[[p_1 \circ P_{\triangle}]^{CO} \circ \mathit{NewC} \circ \mathit{New} \circ \mathit{Opal} \circ \mathit{New} \circ \mathit{Ruby} \circ \mathit{Front} \circ \mathit{Forget}]^{CO}$

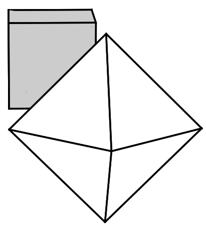
This reconstructs Ross's argument using the lineland modal space. Sentence (41a) is true with reference to the picture in world p_1, and false with reference to the picture in p_2, using a centered semantics computed as in (42). Using a non-centered semantics for the pictures can not give this result, because the propositional semantic values of the pictures are the same.

All of this shows that whether Ross's argument works or not depends on specifics of the modal space and of the projection procedure.

6. Back to 3D

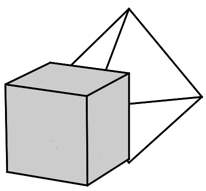
There are ways of using pictures to give information about three-dimensional worlds where the pictures are not intended to carry as much information as they do in the projective semantics from Section 2. Keisha owns some regular polytopes. She told us about them by uttering the sentence (43a), and then showing the picture (43b). She intended to give information about the shape, color and relative orientation of her polytopes, but did not intend to imply anything about what else is or is not in the vicinity. She did not, for instance, intend to rule out the possibility that her polytopes are surrounded in every direction by spheres.

(43) a. I own two regular polytopes. This is how they are oriented.

b. 

c. In the picture, my favorite polytope is in front.

This example can be turned into a Ross example by continuing as in (43c). The sequence carries the information that the favorite polytope is an octahedron. But if the picture is switched to (44), we get the information that the favorite polytope is a cube. (43b) and (44) are projected from the same world, but different viewpoints.

(44) 

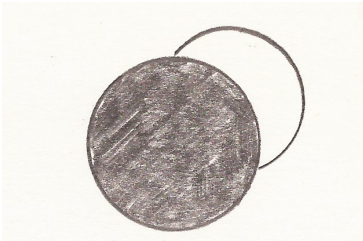
The above suggests fixing the argument by incorporating information about what objects are depicted. Keisha's intention comes down to not intending to depict anything other than her two polytopes. We suggest locating this in the marking rule. Often, pictures are used assuming marking rules with non-geometric side conditions. We can draw a map-like picture projected from above the northern reaches of our university campus, marking red for projection lines that intersect buildings belonging to the university, and gray for other buildings. Here red indicates ownership by the university, not anything geometric. In the same way, the marking rule can stipulate that only objects belonging to Keisha have an influence on marking.

Suppose the first sentence in (43) sets up a discourse referent X_2 for two polytopes owned by Keisha. Before the picture is processed semantically, a marking rule is accommodated that marks only elements of X_2, see (45). If there are spheres surrounding the polytopes, these do not affect the picture. So with this marking rule, the picture does not carry the extra information that came up in Section 3.

(45) Mark a point in the picture plane in black if the directed line from the viewpoint through that point intersects the edge of an element of X_2 before it intersects any other element of X_2, otherwise in gray if the directed line from the viewpoint through that point intersects a black element of X_2 before it intersects any other element of X_2, otherwise in white.

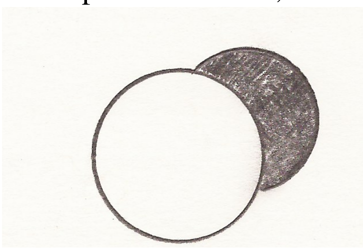
With a context and marking rule like this, we are back in business with a 3D version of Ross's argument. The pictures give the same information about the relative orientation of the objects belonging to Keisha, and the context and marking rule ensure that no other objects are depicted. The argument stated for spheres is given in (46)–(47). The centered contents are different, and the last sentence in (46) can come out true, while the last sentence in (47) comes out false. But the propositional contents are the same, indicating that no semantic rule that uses a propositional content for pictures can work.

(46) Keisha owns two spheres$_3$. This is how they are oriented.
(Accommodate a marking rule that ignores objects that are not elements of X_2, marks black spheres in black, and white spheres in white.)



In the picture, there is a black sphere in front of a white sphere. Both belong to Keisha.

(47) Keisha owns two spheres$_3$. This is how they are oriented.
(Accommodate a marking rule that ignores objects that are not elements of X_2, marks black spheres in black, and white spheres in white.)



In the picture, there is a black sphere in front of a white sphere. Both belong to Keisha.

This reconstructs Ross's argument from the spheres for centered pictorial contents. The moves we made with the marking rule are motivated, because speakers do use pictures intending that only certain specified or contextually determined objects are depicted. The contrast between this version of the argument and the original one indicates that whether or not different centered contents can collapse into a single propositional content depends on details of the marking rule.

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The Acquisition of Disjunctions: Evidence from German Children[1]

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Abstract. Adults' interpretation of disjunction *or* depends on the sentential environment in which disjunction occurs. Putting aside numerous special cases (see e.g. Klinedinst and Rothschild 2012, Meyer 2012, 2016), adult behavior can be summarized as such: In downward entailing contexts, *or* is interpreted logically as the inclusive disjunction OR. But in upward entailing contexts, *or* is interpreted pragmatically as the exclusive disjunction XOR. Summarizing recent work on the acquisition of disjunction, children around age 5 seem to differ slightly: In downward entailing and free choice contexts, children seem to interpret disjunction like adults as inclusive OR (Chierchia et al. 2001, Crain 2008, Su and Crain 2013, Tieu et al. 2016). But in upward entailing, non free choice contexts, children have been found to interpret disjunction sometimes conjunctively as AND (Singh et al. 2016, Tieu et al. 2017).

Singh et al. (2016) advocate an account of the AND interpretation of *or* in terms of scalar implicature (or exhaustivization). In this paper, we present evidence for a novel alternative account based on lexical ambiguity. Specifically, we test the following prediction of the implicature account: Whenever implicatures are obligatory, children should obligatorily interpret *or* as AND. We show that the ambiguity theory makes the opposite predictions, and that the prediction of the ambiguity theory is borne out in data from German children.

Keywords: disjunction, implicature, acquisition, German, coordination, propositional logic

1. Introduction

Disjunction might be considered one of the *lab animals* of pragmatics. But despite the fact that pragmaticists have talked about disjunction at least since Grice's 1975 work, recent work has exposed several new aspects of the meaning and use of disjunction. In particular, Bowler (2015), Meyer (2012, 2016), Singh et al. (2016), and Tieu et al. (2017) argue that unembedded disjunction can be strengthened to a conjunctive interpretation in some cases for at least some groups of speakers. Our interest in this paper is primarily children's interpretation of disjunction. We set out to experimentally compare two possible accounts of the child data: The first account is the *implicature theory*, which is proposed for the child data by Singh et al. (2016) and derives from work by Fox (2007) and Kratzer and Shimoyama (2014) on free choice disjunction. The other account, the ambiguity theory, builds on the assumption that children consider a word such as *or* ambiguous between the *or* and the *and* interpretation, before they know the adult interpretation. In the remainder of this introduction, we consider both accounts in a little more detail. We then describe how an experimental design originally used by Tieu et al. (2017) tests a difference in prediction between the two accounts. While Tieu et al. (2017)

[1]We would like to thank Lyn Tieu for letting us reuse the experimental materials from Tieu et al. (2017), Rob Truswell for editorial comments, and audiences at the Disjunction Days Workshop at ZAS in 2016 and the Sinn und Bedeutung conference at Edinburgh in 2016 for helpful comments. This work was supported financially in part by the Bundesministerium für Bildung und Forschung (BMBF), grant 01UG1411 and by the Deutsche Forschungsgemeinschaft (DFG), grant SA 925/11-1.

report results from French and Japanese, we discuss results from German children in this paper.

The implicature theory assumes that adults and children associate different alternative sets with *or*: While Alt(A *or* B) = $\{A, B, A \vee B, A \wedge B\}$ for adults (Sauerland 2004 and others), for children Alt(*A or B*) = $\{A, B, A \vee B\}$. This predicts that adults strengthen the interpretation of *A or B* to exclude $A \wedge B$ when implicatures are computed. But children are predicted to strengthen *A or B* by excluding $A \wedge \neg B$ and $B \wedge \neg A$, which predicts the conjunctive interpretation.

When implicatures are optional, children are predicted to assign either a logical *OR* interpretation to *or* when they don't compute an implicature, or a strengthened *AND* interpretation when they compute an implicature. The implicature theory predicts therefore that the conjunctive interpretation should be obligatory when implicature computation is obligatory.

The Ambiguity Theory provides an alternative account of the child data as we understand it. The account is in part motivated by the observation reported to us that French children should not be familiar with the disjunction marker *soit* ... *soit* that Tieu et al. (2017) included in their experiment. The implicature theory assumes though that children know that a morpheme is interpreted as logical disjunction and then strengthening to conjuntion applies, which then explains the conjunctive interpretation observed by Tieu et al. (2017). If children aren't familiar with a connective, though, the starting point is already different.

We propose that *or* is ambiguous for children between two interpretations, a disjunctive and a conjunctive interpretation. The restriction to these two interpretations we see at this point as a preliminary assumption that is up to further discussion. In part, the assumption is motivated by the fact that many languages lexicalize these to binary boolean operators while operations such as NAND, NOR, and exclusive disjunction XOR are to the best of our knowledge not lexicalized in the languages. The ambiguity theory assumes furthermore that children apply the strongest meaning principle (SMP) in (1) to resolve the ambiguity.

(1) *SMP:* If S is ambiguous between interpretations α and β with $\alpha \rightarrow \beta$ then the weaker interpretation β is inaccessible (Dalrymple et al. 1998 and others).

The ambiguity theory predicts all the data that have motivated the implicature theory. Consider first *or* in an antitone context.[2] (2) from Chierchia et al. (2001) is predicted to be ambiguous for children between α and β. But because reading β logically entails α, α is correctly blocked by the SMP.

(2) Every dwarf who chose a banana **or** a strawberry received a jewel.
$*\alpha$: Every dwarf who chose a banana *and* a strawberry received a jewel.
β: Every dwarf who chose a banana *or* a strawberry received a jewel.

But in an isotone context, the entailment relationship is the reverse. Therefore the OR-interpretation is blocked in (3).

[2] We use the order-theoretic terms *isotone* and *antitone* of e.g. Birkhoff (1940) instead of the terms *upward* and *downward monotone* of elementary calculus, which are more popular in the linguistic literature.

(3) Every boy is holding an apple **or** a banana. (Singh et al. 2016)
α: Every boy is holding an apple **and** a banana.
$*\beta$: Every boy is holding an apple **or** a banana.

But the ambiguity theory makes different predictions from the implicature theory for cases where implicatures are obligatory. As discussed by Spector (2014) and others, *exh* is ungrammatical when it cannot exclude any alternatives. The same constraint applies to *only*, and causes the ungrammaticality of **I ate only ALL.* Since AND is the maximally strong item in an UE context, obligatory exhaustivization blocks the AND-interpretation. Therefore the ambiguity theory predicts that only the OR-interpretation can be available when implicatures are obligatory.

2. Previous study: Tieu et al. (2016)

Spector (2014) and Nicolae and Sauerland (2016) argue that complex disjunctions, such as French *soit–soit* and English *either–or* involve obligatory exhausitivization. This predicts that children arrive at the strengthened *AND* more frequently with complex form of disjunction than with their simple counterpart, *ou* in French or *or* in English. An example from Japanese experiment is shown below.

(4) a. Osaru-san-ga mado-**ka** doa-o aketa.
monkey-Nom window-KA door-Acc opened
'Monkey opened the window or the door.

b. Osaru-san-ga mado-**ka** doa-**ka**-o aketa.
monkey-Nom window-KA door-KA-Acc opened
'Monkey opened the window or the door.'

Tieu et al. (2016) report an experiment (truth-value judgment task), testing this prediction. They conducted the experiment in French (complex *soit–soit* vs. simple *ou*) and in Japanese (complex *ka–ka* vs. simple *ka*). They replicated the earlier finding by Singh et al. (2016) in both French and Japanese and found that young children accept the use of disjunction in 2DT contexts. Their main findings were that (1) children, as previously observed by Singh et al. (2016), accept the use of disjunction in both context where one or where both of the disjuncts are true, whereas adults accepted only the exclusive interpretation (i.e. that rejected the sentence when both disjuncts were true, but accepted it when only one was true).

On the one hand, this is expected: according to the impicature analysis, children do not have $\{A \wedge B\}$ as the alternative for the disjunction, and hence, when they exhaustivize the meaning of disjunction, they end up with only the conjunctive interpretation, AND. On the other hand, that there was no difference between simple and complex disjunction is puzzling, if we take the implicature analysis literally.

This puzzle lead us to test the disjunction in German, which has different morphological and syntactic characteristics from French *soit–soit*/*ou* and Japanese *ka–ka*/*ka*. In both French and Japanese, the complex disjunction involves a repetition of the same form. In German, however, the complexity is indicated by the morpheme *entweder*, which is distinct from a simple form and only occurs as part of the complex disjunction.

3. Experiment: Truth-Value Judgment Task

In the present experiment, we tested children's comprehension of *oder* vs. *entweder–oder*. We adopted the design of Tieu et al. (2017) to German. The two experimental conditions were the 1DT (one disjunct true) and 2DT (two disjuncts true) scenarios. For sentence (5), the two scenarios are described in (5a) and (5b).

(5) Monkey (either) opened the window or the door. (translated from German)
   a. **1DT:** Monkey opened only the door (or Monkey opened only the window)
   b. **2DT:** Monkey opened both the window and the door

In addition, we varied across subjects whether the items included complex *either–or* or simple *or*. Participants were randomly assigned to one of the two conditions.

3.1. Method

3.1.1. Participants

64 monolingual German speaking children (4;2-8;6) and 21 adults participated in this study. We divided children into two age groups: 31 4-6 year olds (4;2-6;11, *M*=5;2), and 38 7-8 year olds (7;0-8;6, *M*=7;8). Child participants were recruited at one day care center and two public schools in Berlin, Germany. Adult speakers were recruited from the participant pool of Humboldt University, Berlin. Child participants received a sticker for their participation. Adult participants received 5 euro for their participation in the study.

3.1.2. Material

We used simple (*oder* 'or') and complex (*entweder–oder*) disjunctions in German, and constructed two versions of experiments, using only one type of disjunction for each version. An example of the test material is shown below.

(6) Das Huhn hat das Flugzeug oder den Bus geschubst.
   the chicken has the plane or the bus pushed
   'The chicken has pushed the plane or the bus.'

(7) Das Huhn hat entweder das Flugzeug oder den Bus geschubst.
   the chicken has either the plane or the bus pushed.
   'The chicken has pushed either the plane or the bus.'

Participants were introduced to the context in the form of a story. On the first slide, the stroy was told from the iPad. On the second slide, a puppet appeared on the monitor and predicted what might have happened next. The prediction contained a disjunction. On the third slide, the end of the story, which was either 1DT, 2DT, or 0DT, was shown. Participants were then asked whether the puppet made the right prediction: whether what the puppet said matched the ending of the story or not. They put a stamp on the answersheet (under a smily face when matched, under a sad face otherwise). When the story and the prediction did not match, the participants were asked to state what was wrong with the puppet's prediction. The whole experiment was audio-recorded, and later checked for the responses and explanation children made.

3.2. Result

Let us first consider children's responses for the 1DT contexts (in which only one of the disjuncts was true). Let us first consider the participants who were 4 to 6 years old, which is more comparable to the previous study by Tieu et al. (2017).

With simple disjunction, younger participants accepted the use of disjunction in 1DT context 73.3% of the time (44/60), and older participants accepted it in the same context 88.9% of the time (64/72). The difference between the two age groups was significant (Fisher's Exact test, $p<0.05$). With a complex disjunction, younger children accepted the use of disjunction in 1DT context 85.7% of the time (48/56), and older children did so 80.9% of the time (55/68). The difference in the ratio between acceptance and rejection between the two age groups was not significant (Fisher's exact test: $p=0.6313$). No other comparisons were significant.

Next consider children's responses for the 2DT context (in which both of the disjuncts were true). With simple disjunction, younger participants accepted its use in 2DT context 67.8% of the time (40/59), whereas the older participants did so 52.8% of the time (38/72). The difference in the ratio between acceptance and rejection between the two age groups was not significant ($p=0.1074$). With complex disjucntion, younger participants accepted the use of disjunction 58.9% of the time (33/56), and older participants did so 39.7% of the time (27/68). The difference in ratio between the two groups was statistically significant ($p<0.05$). No other comparisons were significant. Most importantly, as is the case in French and Japanese, the difference between simple and complex disjunctions was not significant.

Let us now combine the results from both conditions and plot where each individual falls. In figure 1, we have plotted, for each individual, the score for 2DT contexts along the Y-axis, and the score for 1DT contexts along the X-axis. Let us first explain what the chart shows. When a speaker is in the XOR corner, that is when they accepted the use of disjunction in 1DT while rejecting its use in 2DT. When a speaker is in AND, on the other hand, it means that the speaker accepted the use of disjunction in 2DT context, while they rejected its use in 1DT context. A speaker in the OR corner accepted the use of disjunction in both 2DT and 1DT contexts. As expected, the adults are mainly in the XOR corner because of the implicature and only one is in the OR corner, and one rejected all conditions with *oder*. Children are distributed over three different corners except for the double rejection corner on the bottom left. However, especially among the 4–5 year old children only 2 are in the AND corner at this point. Instead it seems

Figure 1: Distribution of subjects by acceptance of 1DT (x-axis) and 2DT (y-axis) acceptance across the three age groups. Each grey dot represents a participant of the simple *oder* group, each red dot one of the *entweder–oder* group. Some random 'jitter' is added to the plot to reduce overlap of dots, the actual values are at round multiples of 20%.

that the 4–5 year old children most frequently access the inclusive interpretation for *oder* and also *entweder–oder*. No clear difference is apparent figure in 1 between the grey dots of the subjects that received the *oder* condition and the red dots of those receiving the *entweder–oder* condition.

3.2.1. Discussion

At this point, we would like to compare the results from Tieu et al. (2017) on French and Japanese. Recall that this study did not find differences between simple and complex disjunctions, on the one hand, and between French and Japanese children, on the other hand. Comparing the results from the three languages in figure 2, we note that German children are distributed more in XOR and OR areas, whereas Japanese and French children are distributed more in AND and OR areas.

We ran a mixed model logistic regression, with complexity and language as dependent variables. We found that language is a factor ($p < 0.01$), although the complexity alone is not ($p = 0.081$). In addition, we found an interaction between the language and complexity, however, showing that German children are significantly more sensitive to complexity than Japanese children are.

Recall that according to the implicature theory, we expect that children should (1) accept the use of disjunction in 2DT context, and (2) reject the use of disjunction in 1DT context. Furthermore, adopting Spector (2014), we assume that complex disjunction necessarily involves exhaustivization. These assumptions combined predict that more children should be in AND

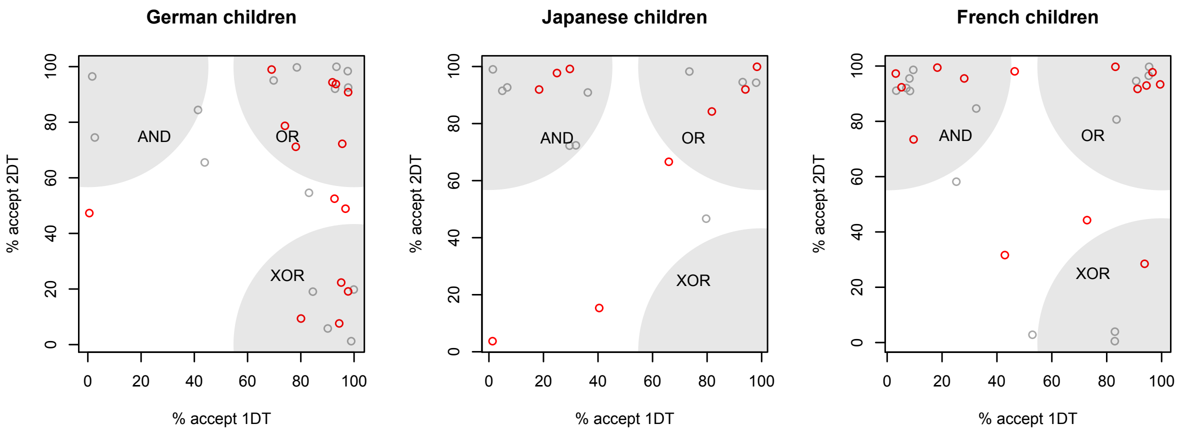

Figure 2: Comparison of the results from German, Japanese and French 4–5 year old. As in figure 1, each grey dot represents a participant of the simple disjunction group, each red dot one of the complex disjunction group.

area when tested with a complex disjunction than when tested with a simple disjunction. Since we didn't find any significant difference between the two types of disjunction, our result doesn't allow us to exclude the implicature theory. The ambiguity theory makes the opposite prediction as the implicature theory: more children should assign a conjunctive interpretation in the simple disjunction condition than the complex disjunction condition more frequently. Again our presently non-significant finding doesn't allow us to exclude this prediction.

Another prediction of the ambiguity theory, though, seems problematic in light of our results. Namely on the ambiguity theory, complex disjunctions involve obligatory exhaustivization, and therefore only the exclusive disjunction interpretation should be possible in the complex disjunction condition. Though we find some German children who assign an XOR interpretation, there is nevertheless a sizable group of children in all three languages who assign an inclusive disjunction interpretation to complex disjunction.

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Aligning intentions: Acceptance and rejection in dialogue[1]

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Abstract. This paper presents an operational and grounded notion of *intention in dialogue* and links it to the *commitments* that speakers make in dialogue. We take these two concepts to then develop a conceptually sound way of doing formal pragmatics. Our model tackles a number of relevant phenomena: (i) we formally derive the illocutionary forces of the speech acts of *asserting* and *rejecting* a proposition; (ii) we give a suitable semantics to rejections of arbitrary speech acts, including rejections of rejections; (iii) we demonstrate how *cooperativity* is linked to how strongly the notion of *speaker commitment* is understood. That is, how tightly bound speakers are by their commitments directly influences how cooperative they are.

Keywords: dialogue, commitment, intention, acceptance, rejection

1. No mindreading

Nobody knows what's in someone else's head. This is a simple truism (Lepore and Stone, 2014). Yet, in conversation, we reason about our interlocutors' thoughts, desires and intentions—while the truth of these internal mental states remains obscure to us. This is a curious tension and it begs for resolution. At least two challenges are at hand here: in what sense can intentions be *public knowledge* as required for successful conversation, and where does that knowledge *come from*. The intuitive solution to both challenges lies in the follow-up truism that *we can only observe how other people behave*—and then draw conclusions about their mental states.

One promising approach, developed the furthest by Asher and Lascarides (2008, 2013), is to supply the interpreter of an utterance with some *default expectations* about what people engaged in dialogue intend. A simple example is that *askers of questions typically intend to get an anwer* and the less simple dual *utterances following questions are typically intended as answers*. Our main interest in this paper lies with the pragmatic principles underlying the sharing of knowledge. Asher and Lascarides provide us with the following default principles governing this process.

(Intent to Share Commitment) $C_A\varphi > C_A I_A C_B \varphi$.

(Cooperativity) $C_A I_A \varphi > I_B \varphi$.

Here, $>$ denotes a default conditional ($p > q$ expressing roughly that 'if p, then typically q'), $C_A\varphi$ means that the speaker A is publicly *committed* to the formula φ and $I_A\varphi$ means that the speaker A *intends* to establish a state that brings about φ. The first axiom expresses that, typically, commitments are intended to be shared. The second axiom expresses that, typically,

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publicised intentions are shared. The sharing of commitment is supposed to be part of the purpose of an assertion (Stalnaker, 1978) and the uptake of intention to be a fundamental part of conversation (Clark, 1996). If we assume that a speaker A asserting the proposition p entails that A undertakes a commitment to p ($C_A p$), we can compute *agreement* as follows ($\approx\!\!\!\!\mid$ is a defeasible inference building on $>$).

$C_A p$ (A asserts that p).

$\mid\!\approx$ $C_A I_A C_B p$ by (Intent to Share Commitment).

$\mid\!\approx$ $I_B C_B p$ by (Cooperativity).

$\rightsquigarrow$ B will agree.

This is an appropriate derivation, but a few things are left open. First, regarding the meaning and truth-conditions of the operators I_A/I_B: while Asher and Lascarides (2003, 2008) give a modal semantics to these operators, it is unclear what this semantics represents. As said above, intentions are inherently private to the interlocutors; so it is difficult to say when $I_A\varphi$ is true and, if it is, what grounds its truth. We want to find a *grounded* and *operational* notion of intention. By *grounded* we mean a notion that ties in with observable behaviour; by *operational* a notion that is suitable for inference and admits motivated truth-conditional scaffolding.

Second, we wonder about the status of *Intent to Share Commitment* and *Cooperativity* as axioms. The question is what licenses their stipulation and in what sense, if any, they express truths. One can surely take them to be non-trivial *empirical* facts, but we think it more principled to derive them from more basic principles. Third, the above representation leaves open what happens in noncooperative situations: the *Cooperativity* axiom is crucial to the derivation above, but it is unclear what replaces it in noncooperative settings. This ties in with the second issue; we seek a more basic principle that generalises *Cooperativity* and reduces to it in appropriate circumstances.

Thus, our goal is to buttress a theory of intentions in formal pragmatics on conceptually solid footing. We proceed towards that goal as follows. In the next section we give a discussion of our conception of dialogue intentions as *commitments to preferred futures* and address some conceptual and practical challenges to this conception. We will show how this notion allows us to do formal pragmatics by formally defining the *basic principles* that govern intentionality in dialogue. Afterwards, we can derive some previously stipulative facts from them, including the illocutionary forces of assertion and rejection; also, we establish a link from cooperativity to commitment. Before concluding, we outline a truth-conditional semantics backing our derivations.

2. Intentions and commitment

Research on intentions divides up into two camps: one that studies intentions as attitudes towards actions or plans (Bratman, 1987) and one according to which intentions are propositional attitudes (Cohen and Levesque, 1990). Given that dynamic semantics (Groenendijk and Stokhof, 1991), in which the contents of a sentence form an action to update an information context, has blurred the line between actions and propositions, our model will have features of both approaches to intention. We will model intentions as being towards achieving a certain propositional *state*. Such states, naturally, are achieved through action, but we do not model an intention to the action.[2]

As mentioned, our concern lies with the meaning of intentional operators like I_A above. We first observe that having an intention has an inherently temporal component: an intention relates to some (potential) future act. Furthermore, intending an act or state α includes a certain dedication to undertake that act or bring forth that state. This is a stronger attitude than merely *preferring* α over not-α or desiring or wanting α. For a simple example, consider someone who desires to go out for fine dining, but cannot afford to do so. It is perfectly reasonable to attribute the cognitive attitude "she wants to go out, but chooses not to" to someone, but "she intends to go out, but chooses not to" strikes us as more than just a little odd.

We can conceptualise this dedication to action as a notion we already understand: *commitment*. We can say that an intention to α can be represented as a *commitment* (to oneself) to bring about α and a publicised intention to α as a *public commitment* (to one's interlocutors) to bring about α. It is useful to compare this to the felicity conditions for speech acts by Austin (1962). According to him, a successfully performed speech act must be made with the right intentions and, moreover, these intentions must be apparent to one's addressees so they can take them up properly. In the terminology we have started to develop here, a speech act publicises a commitment to a (potential) future state or act; uptake consists in the addressees sharing the commitment. Only after all participants have thereby fulfilled the intentional felicity conditions does the illocutionary force of the act apply. We will return to a model for illocutionary force in the next section.

Thus, we can express an intentional operator derivatively from operators we already understand quite well: the operators for *commitment* (C_A, C_B) and *temporal modal operators* which we will put as $\Diamond$ ('eventually') and $\Box$ ('from now on', equivalent $\neg\Diamond\neg$).[3] We can thus represent 'A intends that α' as $C_A\Diamond\alpha$ ('A commits that eventually α obtains'). There is, however, a sleight of hand in this representation: we only understand commitment as *public* commitment, but have no grasp on (not publicised) commitments to oneself. This, however, is not a problem for our project. As far as intentions are required for the understanding of a speech act, they ought to be (implicitly or explicitly) publicised. In fact, the intentions going along with a speech act must be *apparent* to the addressee of that act.[4] Making explicit how implicit intentions are apparent from observable behaviour is the major drive behind the pragmatics we develop in the next section.

[2]We ignore here certain pathological cases where someone does the right thing for the wrong reasons; e.g. intending that α, executing an ill-conceived plan to bring forth α, and just by chance achieve α in the process nonetheless.

[3]More complex temporal logics such as LTL (Pnueli, 1977) would arguably be a more appropriate choice here. For simplicity we remain with the normal modal logic language. We formalise temporal modal logic below as KT4; we do not need additional machinery, and KT4 seems to express universal truths about temporal reasoning.

[4]In noncooperative settings the apparent intentions might be purposefully misleading; nonetheless, one needs to display *some* intention (even if it is dishonest) when making a speech act.

For now, we must address a more pressing concern. Our semi-formal logical form $C_A\Diamond\alpha$ for the intention that α is indistinguishable from the claim that α *will happen* (if one understands claiming that p as the undertaking of a commitment to p). Surely, claiming that something will happen is much stronger than intending it. The difference is, however, smaller than it appears. As argued above, an intention α incurs a dedication to bringing forth α. It is a minor step from there to conclude that the publicised intention to α amounts to the claim that one will cause α unless something unexpected happens. As a case in point, notice that it is absurd to intend something impossible.[5] In this sense, we can understand intentions as *defeasible* commitments: they reduce to the claim that the content of the intention will obtain *unless* circumstances unexpectedly prevent this.

With the preliminaries settled, we can now formulate a principle that we take to be *partly constitutive* of commitment in dialogue. Undertaking a commitment includes a certain dedication to upholding the commitment. Quite literally, a commitment that is undone without much ado is not a commitment. Thus we consider it a first principle of commitment that one does not intend to undo the commitment. We can therefore stipulate the following as fundamental axioms for our pragmatics.

Definition 1 (Basic Principles)**.** The following axioms are (partly) constitutive of commitment:

(a) $C_S\varphi > C_S\Box C_S\varphi$ (for each speaker S).

(b) $C_S\neg C_S\neg\varphi > C_S\Box\neg C_S\neg\varphi$ (for each speaker S).

(c) $C_S\Diamond C_S\Diamond\varphi > C_S\Diamond\varphi$ (for each speaker S).

The principle (a) states that if one makes a commitment, one intends to keep it (equivalently, does not intend to break it; $C_S\neg\Diamond\neg C_S\varphi$). Principle (b) states that if someone commits that they *might* commit to something (understanding $\neg C_S\neg$ as the dual to C_S), they also intend to keep that commitment. Note the difference to $\neg C_S\neg\varphi$ which merely expresses that φ is compatible with S's commitments; in this case, S can easily commit to either φ or $\neg\varphi$ later without dropping any earlier commitment. In contrast, $C_S\neg C_S\neg\varphi$ expresses that S has *committed* to potentially also committing to φ—hence committing to $\neg\varphi$ requires dropping this earlier commitment. Finally, principle (c) expresses that an intention to intend something reduces to a single intention.

Note that we model intentions as intending *states*, not *acts*. If someone intends an act, completion of that act should resolve the intention. In our case, with speakers intending states, once the state is achieved the intention is preserved as the intention to *maintain* that state.

These axioms have privileged epistemic status over the principles *Intent to Share Commitment* and *Cooperativity* we discussed in the Introduction. The principles in Definition 1 are *constitutive* of commitment: that one intends to keep a commitment lies at the core of what it means to commit. We also maintain the Basic Principles in noncooperative settings; if commitment is the

[5] There might be situations where a speaker claims to intend something objectively impossible; in such cases, the speaker is mistaken. This seems to be similar phenomenon to someone claiming to *know* something false.

basic operation in dialogue and these principles are foundational to commitment they need to be maintained (at least as a pretense) even in noncooperative dialogue.[6] A prototypical noncooperative action is a lie; lies only work since the defeasible inference from public commitment to private belief is active even in noncooperative settings (i.e. *ceteris paribus* both parties are still assumed to speak truths). Similarly, the Basic Principles allow the noncooperative move of making false commitments—commitments one has no intention of keeping (e.g. an unfaithful promise).[7] The possibility to be insincere extends to publicised intentions as well: one can commit to intending something without actually intending it—hence (c) is a default as well.

To complete the picture it is left to give meaning to the temporal operators. As for the present model we only require future-oriented operators, we characterise them as the normal modal logic KT4.

Definition 2 (Temporal Logic)**.** For the sake of simplicity, we model temporal operators as KT4 modal logic:

(K) $\Box(\varphi \to \psi) \to (\Box\varphi \to \Box\psi)$.

(T) $\varphi \to \Diamond\varphi$. (If something is true now, it is also true eventually.)

(4) $\Diamond\Diamond\varphi \to \Diamond\varphi$. (If it is eventually the case that eventually φ, then eventually φ.)

3. Formal pragmatics of acceptance and rejection

In the previous section we have developed the foundation to our formal pragmatics. We now develop a framework on top of this foundation that allows us to model the pragmatics of acceptance and rejection in dialogue.

3.1. Asserting and rejecting propositions

The first task is to define what asserting and rejecting a proposition means with respect to public commitment. As already hinted at in Section 1, it is intuitive to think of an *assertion that p* as the undertaking of a commitment that *p* holds. This intuition sketches a general plan to capture the semantic effects of *A* asserting *p*: one needs to update a *conversational record* with the information that *A* committed to *p*.

While this intuitive idea constitutes a standard line of research (Brandom, 1983; Asher and Lascarides, 2008), putting it to work requires us to make some fundamental modeling choices: primarily, we need to define what the conversational record *is* and how it *changes* during conversation. That is, we need a formal representation of conversational records from which com-

[6] This corresponds roughly to what Asher and Lascarides (2013) call *basic cooperative*: the minimal cooperativity required to engage in conversation at all.

[7] One can argue that such insincere commitments are not commitments at all. We agree in principle, but the insincere speaker still *feigns* a commitment. And since we are concerned with observable behaviour only, we need to deal with such deceit and the consequences it has in a dialogue.

mitments can be easily projected. Then we need to capture the *immediate* effects of an assertion on this record; making the model too smart, so to speak, would go against our project of finding minimal, constitutive principles.

We can rely on existing work for this. Commitments are representable in static modal logic models (Asher and Lascarides, 2008), and Venant and Asher (2015) show how assertions enact *dynamic* updates of these models. Their model in particular accounts for updates associated with assertions that dispute previous commitments (undertaken by oneself or others). Furthermore, Venant and Asher (2016), building on Asher and Lascarides (2003), give a general method to link such models to a complex language for semantic representation and interpretation in a discourse context.

It is however not obvious how one ought to understand the *rejection of p* in such a framework. There is a clear intuition that rejection operates dually (in some way) to assertion; that is, rejection is the speech act that cancels or reverses an assertion. An old idea is to reduce rejection to assertion by claiming that a rejection of p is equivalent to the assertion of $\neg p$ (Frege, 1952; Rumfitt, 2000). This idea does not seem to capture the breadth of linguistic data. For instance, Grice (1991) provides us with an example where a rejection of a proposition p is not equivalent to asserting that that p is false.[8]

(1) If you say "X or Y will be elected," I may reply "That's not so; X or Y *or* Z will be elected." Here, too, I am rejecting "X or Y will be elected" not as false but as *unassertable*. (Grice, 1991: p. 82, his emphasis)

Similarly, Stalnaker (1978) remarks in a footnote that to reject is not to assert a negative, but to refuse to accept (p. 87, footnote 9). Given Grice's example and similar cases we agree with Stalnaker on this. Incurvati and Schlöder (2017) give multiple equivalent ways to formalise this conception; their commitment account models a speaker A rejecting p as undertaking a commitment *not* to commit to p, $C_A \neg C_A p$. Our Basic Principles (Definition 1) predict that this is correct: $C_A \neg C_A p$ entails—by the Basic Principles—$C_A \Box \neg C_A p$. This can be read as A publicising the intention not to commit to p and thereby not to agree to p. This coincides with Stalnaker's remark and with our intuition that a rejection is the dual speech act to assertion.

Definition 3 (Assertion and Rejection)**.** Let A be a speaker and p be a proposition.

In asserting that p, A undertakes the commitment that $C_A p$.

In rejecting p, A undertakes the commitment that $C_A \neg C_A p$.

3.2. Deriving illocutionary force

We now have described what commitments a speaker undertakes in performing the speech acts of assertion and rejection. The next question is what the *purpose* of these speech acts is. We

[8] Others have made similar arguments, e.g. Dickie (2010) and Walker (1996).

follow Austin (1962) in saying that one makes a speech act with a particular intention. We can formalise this as follows.

Definition 4 (Speech-Act Related Goals)**.** If a speaker A makes a speech act and we can derive from the resulting commitment structure that $C_A \Diamond \gamma$ then γ is a *Speech-Act Related Goal (SARG)* of that act.

Trivially, according to the Basic Principles in Definition 1, it is a SARG of any speech act to maintain the commitments undertaken by making that act. However, committing to a proposition is rarely if ever a goal in and of itself, so there must be something more to their purpose. To answer this question, we first must ask what the overall purpose of conversation itself is; since speakers make speech acts to engage in conversation, their purpose can only be understood with respect to the purpose of the conversation.

The traditional conception has it that the goal of a conversation is to *exchange information* (Stalnaker, 1978; Skyrms, 2010). In other work (Asher et al., 2016; Asher and Paul, 2016), some of us have argued that conversations have many purposes that are not plausibly analysable as an exchange of information. For example, two politicians in a debate are often not exchanging information with each other but rather setting forth arguments and providing information to convince an audience, which might be not necessarily they themselves, but their peers, a committee, or an electorate. Thus, Asher et al. (2016), Asher and Paul (2016) abstract away from all these *particular* circumstances and conceive of conversations, at utmost generality, as being about achieving certain winning conditions with respect to an abstract *Jury*.

For the purposes of this paper, we will assume that these winning conditions are expressible in a standard propositional language and thus can be put as the goal to *convince the Jury*. On our commitment account, agreement between two interlocutors is to share a commitment. Hence we can fix another basic principle: both speakers engaged in a dialogue *intend to establish their commitments as shared with the Jury*. While in Definition 1 we recorded basic principles of *commitment*, we now fix this principle as partly constitutive of the activity of *conversing*.

Definition 5 (Basic Principles)**.** Let A and B be speakers engaged in conversation and let J be the Jury; let Φ be the finite set of issues raised in the dialogue. The following axiom is (partly) constitutive of conversing:

(d) $C_A \Diamond \Box \bigwedge_{\varphi \in \Phi}(C_A \varphi \leftrightarrow C_J \varphi)$ and $C_B \Diamond \Box \bigwedge_{\varphi \in \Phi}(C_A \varphi \leftrightarrow C_J \varphi)$.
Speakers intend to reach agreement with the Jury on the issues Φ.

The Basic Principle (d) states that both speakers are committed to aligning with the Jury on all issues φ raised in the conversation. This does not mean to agree to φ, but rather to reach a state where the Jury *shares* a commitment with regards to φ; that is, either both the speaker and the Jury commit to φ or both do not commit to φ. This principle is an idealisation. First, dialogues might be aborted at any point and so leave issues open. Second, speakers might have an argument just for the fun of it (as in debate club), or to convince the Jury of their conversational *ability* and not primarily of the *issues* they raise (as in debate competitions).

The first point does not impugn our general point that it is still their *goal* to resolve issues; the second point concerns situations that are, arguably, still conducted under a pretense of adherence to (d).

Now we are able to derive some particular SARGs of assertion and rejection. The following derivations show that the goal of an assertion is to prompt agreement, and the goal of a rejection is to prompt retraction of a previous commitment (if there was one). First suppose that speaker A asserts the proposition p.[9]

$C_A p$ (A asserts that p).

$\approx$ $C_A \Box C_A p$ by Definition 1, (a).

$\approx$ $C_A \Box\Box C_A p$ by Definition 2, (4).

$\approx$ $C_A \Diamond \Box C_J p$ by Definition 5, (d).

$\approx$ $C_A \Diamond C_J p$ by the dual of Definition 2, (T).

$\rightsquigarrow$ A wants the Jury to share the commitment to p.

Now suppose that speaker B rejects p.

$C_B \neg C_B p$ (B rejects p).

$\models$ $C_B \neg C_B \neg\neg p$ by Double Negation Introduction.

$\approx$ $C_B \Box \neg C_B \neg\neg p$ by Definition 1, (b).

$\approx$ $C_B \Box \neg C_B p$ by Double Negation Elimination

$\approx$ $C_B \Box\Box \neg C_B p$ by Definition 2, (4).

$\approx$ $C_B \Diamond \Box \neg C_J p$ by Definition 5, (d).

$\approx$ $C_B \Diamond \neg C_J p$ by the dual of Definition 2, (T).

$\rightsquigarrow$ B wants the Jury to be not committed to p.

These two SARGs seem to be of particular significance with respect to the Basic Principle (d), and therefore express the conventional purpose that assertion and rejection serve in a dialogue. Thus, we call them the *illocutionary forces* of the speech acts assertion and rejection.

A special case of the latter derivation is in the situation where A has already convinced the Jury of p. Then B's intention is for the Jury to *retract* the commitment to p. This is in particular the case in everyday conversation where the Jury is the speakers themselves; that is, B wants to convince A and A wants to convince B. Then we derive $C_A \Diamond C_B p$ as the illocutionary force of

[9] Again $\approx$ is defeasible inference with defeasible modus ponens on $>$. That is, $p > q, p \approx q$ unless that inference is blocked by information contradicting q.

assertion and $C_B\Diamond\neg C_A p$ as the illocutionary force of rejection. Hence, if A asserts that p, B's rejection of p voices the intention that A retract her commitment to p. Moreover, this means we derive $C_A p \mathrel{|\!\!\approx} C_A\Diamond C_B p$ from basic principles, instead of stipulating the axiom *Intent to Share Commitment* we discussed in Section 1.

3.3. Rejecting rejections and other speech acts

The previous discussion dealt exclusively with rejecting a (previously asserted) proposition. But, in fact, any speech act can be rejected, cancelling its effects (Searle, 1969). A particular case is the rejection of a previous rejection.

(2) a. A: It is the case that p.
b. B: No, it's not.
c. A: Yes, it is.

It is not obvious—in English—that A's utterance in (2c) is a rejection of B's rejection in (2b), rather than a re-assertion of A's own (2a). However, (2) can be translated to German as follows.

(3) a. A: Es ist der Fall, dass p.
b. B: Nein, ist es nicht.
c. A: Doch, ist es.

In this case, A's utterance in (3c) contains the negative polarity item *doch* which requires a negated antecedent. Thus, the utterance that (3c) must rhetorically relate to is (3b) and it is implausible to model it as a re-assertion of p. English lacks a particle like *doch*, but in some cases a rejection syntactically mirrors the shape of a previous rejection. The following are attested examples from the AMI corpus (Carletta, 2007).

(4) a. A: That's dependent on the television.
b. B: No, <u>I don't think so</u>.
c. A: <u>I do know so</u>.

(5) a. A: Mushroom <u>is a vegetable</u>.
b. B: I don't think it is.
c. A: <u>It's vegetable.</u>

In (4), the form of (4c) mirrors (4b), suggesting that (4c) functions as a rejection of the rejection (4b). In contrast, the form of (5c) suggests that it indeed works as a re-assertion of (5a). We note that it is not our goal to argue that rejection-of-rejection and re-assertion have different *effects*; surely, both (4c) and (5c) have the effect of A indicating that she stands by her original assertion. Rather, we want to verify that our approach squares with the data showing that one can reject a rejection. That is, we check that we can make sense of these cases without engaging in undue sleights of hand (such as simply defining rejections-of-rejections to be re-assertions).

Naïvely reproducing the semantics for rejection from Definition 3 will not do. In (6) we have added the resulting commitments, according to Definition 3, to the dialogue from (2). That is, (6a) results in A undertaking a commitment to p and (6b) in B undertaking a commitment not to share A's commitment. However, representing the rejection-of-a-rejection in (6c) as A committing not to share in B's commitment is odd.

(6) a. A: It is the case that p. $C_A p$
b. B: No, it's not. $C_B \neg C_B p$
c. A: Yes, it is. $??C_A \neg C_A \neg C_B p$

Apparently, the way we characterised rejection in Definition 3 is specific to the rejection of a proposition. Rejecting an *act* (other than assertion) appears to be different. Let's try to make sense of this. Speech acts can be *cancelled* which means that their force does not obtain (Searle, 1969), i.e. that the associated intention is not fulfilled. We model rejection now as the speech act that realises the function of cancellation. That is, what a rejection cancels is the *illocutionary force* of its target act; or, more generally, a rejection can target a SARG. Put differently, in a Clarkian (Clark, 1996) understanding of conversation, every move in a dialogue proposes a joint action; execution of the action realises the move's illocutionary force. Thus we can say that to reject a speech act is to *refuse participation* in that act's joint action.

Definition 6 (Rejecting Arbitrary Speech Acts)**.** Suppose a is a speech act with SARG α. To reject that SARG is to commit not to participate in α; that is, not to intend α. Thus, if speaker B rejects α, B is undertaking a commitment to $C_B \neg \Diamond \alpha$. We assume that all else being equal the SARG of a that represents a's illocutionary force is the relevant SARG here.

We can first verify that this generalises on the narrower definition from Definition 3. That is, we can reproduce that rejecting an assertion of p (as in 2b) results in the commitment $C_B \neg C_B p$, i.e. in rejecting the asserted proposition. Since here we talk about the speakers engaging in joint actions, we can model the Jury as the speakers themselves. Then the illocutionary force of an assertion that p is $C_A \Diamond C_B p$. By to Definition 6 the rejection of that act is $C_B \neg \Diamond C_B p$. Hence:

$C_B \neg \Diamond C_B p$ (B rejects $\alpha = \Diamond C_B p$).

$\models$ $C_B \Box \neg C_B p$ by a modal logic validity.

$\models$ $C_B \neg C_B p$ by the dual of Definition 2, (T).

Note in particular that these inferences are non-defeasible; that is, it is an unavoidable consequence of rejecting an assertion (in the sense of Definition 6) to reject the asserted proposition (in the sense of Definition 3).

Now we can check that Definition 6 also felicitously models rejections-of-rejections. In (6b), the illocutionary force we attribute is $C_B \Diamond \neg C_A p$ (as derived earlier). Rejecting this force yields:

$C_A \neg \Diamond \neg A C_A p$ (A rejects $\alpha = \Diamond \neg C_A p$).

$\models$ $C_A \Box C_A p$ by a modal logic validity.

$\models$ $C_A C_A p$ by the dual of Definition 2, (T).

$\rightsquigarrow$ A is committed to her commitment that p.

The intuitive reading of this derivation is that A is confirming or renewing her commitment to p as made in (6a). We think that this is correct for rejecting a rejection.

3.4. Cooperative commitments

Everything said so far goes for cooperative as well as noncooperative settings. Our final goal is to reproduce the *Cooperativity* axiom from Section 1. This axiom models that cooperative speakers adopt publicised intentions. Put differently, once an addressee has *understood* the SARG of an act, she is expected to *take up* that goal. We now demonstrate that this kind of cooperativity varies with the assumptions made on the strength of commitments. Consider the following three modal logic axioms.

$$\text{(D) } \neg C_A \bot \qquad \text{(4) } C_A \varphi \rightarrow C_A C_A \varphi \qquad \text{(5)} \neg C_A \rightarrow C_A \neg C_A \varphi.$$

These axioms formalise some sort of sincerity on commitments: (D)+(5) expresses that one cannot claim to have made a commitment ($C_A C_A p$) that one in fact has not made ($\neg C_A p$); (D)+(4) that a speaker cannot make a commitment to a proposition ($C_A p$) and simultaneously reject it ($C_A \neg C_A p$). To see that these partially express cooperativity, note that (D)+(5) rule out the noncooperative act in (7a) and (D)+(4) the one in (7a′).

(7) a. A: I claimed earlier that p. $C_A C_A p$
(when, in fact, A never asserted p, i.e. $\neg C_A p$)

a.′ A: I never claimed that p. $C_A \neg C_A p$
(when, in fact, A asserted p previously, i.e. $C_A p$)

Claims similar to (7) can be found, e.g., in political debates. This demonstrates that in noncooperative settings one cannot trust one's interlocutor to be sincere about their own commitments. Thus, we refer to KD45 operators C_A as *cooperative commitments*.[10] We now show that if we axiomatise our commitment structures to be KD45 models, we derive the cooperative principle that *understanding entails acceptance*; this inference is of course only made defeasibly, since rejections can occur for innocuous reasons in cooperative settings as well. This precisely formalises the claim of Schlöder and Fernández (2014) that a cooperative addressee is expected to take up a proposal unless there is a reason not to. Apparently, speakers are aware of this default expectation, as evinced by the following attested example from the British National Corpus (Burnard, 2000).

(8) a. A: Do you agree with that?
b. B: I have no reason to disagree. Yes.
(BNC, file FMN, lines 492–493)

First we need to clarify what is meant by 'understanding' on the commitment-based account. Venant et al. (2014) already provide us with a model: understanding is also an attitude that ought to be displayed publicly if it is to be conversationally relevant (this appears to be the

[10] Incurvati and Schlöder (2017) also derive KD45 as the modal logic of cooperative commitment from independently motivated principles.

point of backchannel utterances; also recall our discussion of publicised intentions). Making something public, on the commitment-based account, is always the undertaking of a commitment. Now, according to Venant et al., B understanding that A committed to φ is precisely B committing to the fact that A made that commitment, $C_B C_A \varphi$. We adopt this notion and can now demonstrate that under cooperative commitments, understanding an intent defeasibly entails sharing the intent.

Theorem 7 (Cooperative Commitment)**.** Assume that C_A and C_B satisfy the KD45 axioms and that A considers B her Jury and vice versa. Then $C_B C_A \Diamond\varphi \mid\!\approx C_B \Diamond\varphi$ (and the same for A and B switched).

Proof. $C_B C_A \Diamond\varphi$ (assumption).

$\mid\!\approx$ $C_B \Box C_B C_A \Diamond\varphi$ by Definition 1, (a).

$\mid\!\approx$ $C_B \Box\Box C_B C_A \Diamond\varphi$ by Definition 2, (4).

$\mid\!\approx$ $C_B \Diamond\Box C_A C_A \Diamond\varphi$ by Definition 5, (d).

$\mid\!\approx$ $C_B \Diamond\Box C_A \Diamond\varphi$ by (D)+(5).

$\mid\!\approx$ $C_B \Diamond\Box C_B \Diamond\varphi$ by Definition 5, (d).

$\mid\!\approx$ $C_B \Diamond C_B \Diamond\varphi$ by Definition 2, (T).

$\mid\!\approx$ $C_B \Diamond\varphi$ by Definition 1, (c). $\Box$

Note that Theorem 7 is an accurate analogue of the *Cooperativity* axiom of Asher and Lascarides.

For the two speech acts we have defined here, we can do one better. Theorem 7 shows that understanding a *goal* entails uptake of that goal. The following derivations show that for assertion and rejection it suffices to understand the *act* itself.

$C_B C_A p$ (B understands A's assertion of p).

$\mid\!\approx$ $C_B \Box C_B C_A p$ by Definition 1, (a).

$\mid\!\approx$ $C_B \Box\Box C_B C_A p$ by Definition 2, (4).

$\mid\!\approx$ $C_B \Diamond\Box C_A C_A p$ by Definition 5, (d).

$\mid\!\approx$ $C_B \Diamond\Box C_A p$ by (D5).

$\mid\!\approx$ $C_B \Diamond\Box C_B p$ by Definition 5, (d).

$\mid\!\approx$ $C_B \Diamond C_B p$ by Definition 2, (T).

$\rightsquigarrow$ B intends to share the commitment to p.

$C_B C_A \neg C_A p$ (B understands A's rejection of p).

$\mid\!\approx$ $C_B \Box C_B C_A \neg C_A p$ by Definition 1, (b).

$\mid\!\approx$ $C_B \Box\Box C_B C_A \neg C_A p$ by Definition 2, (4).

$\mid\!\approx$ $C_B \Diamond\Box C_A C_A \neg C_A p$ by Definition 5, (d).

$\mid\!\approx$ $C_B \Diamond\Box C_A \neg C_A p$ by (D5).

$\mid\!\approx$ $C_B \Diamond\Box \neg C_A p$ by (D4).

$\mid\!\approx$ $C_B \Diamond\Box \neg C_B p$ by Definition 5, (d).

$\mid\!\approx$ $C_B \Diamond \neg C_B p$ by Definition 2, (T).

$\rightsquigarrow$ B intends not to commit to p.

The assumption that A and B consider each other their Jury stands to reason in everyday cooperative dialogue. Depending on how one models the Jury, the above derivations and Theorem 7 can also be recovered in a more general setting. For instance, if the Jury is *also* considered to be bound by the Basic Principles (a)–(d), Theorem 7 can be maintained, since then intentions percolate from A over J to B. However, in general, the Jury is a mere overhearer of the conversation and not a participant. So it is potentially bound by a different set of principles.

4. Model theory

A model theory can be obtained by understanding the speech acts we consider as moves in an unbounded conversational game (Asher and Paul, 2013). We start with both participants initial commitments, as represented in a Kripke model satisfying the appropriate axioms. Computing a speech act leads to a model transition; we abstract away from explicitly computing these transitions (though it can be done; see Venant and Asher (2015)). Rather, we consider a conversation to be a sequence of public commitment models, where we tacitly assume that the transition from one model to the next was due to one participant undertaking a commitment by way of making speech act.

Thus, the complete tree of potential conversations is a tree in which each dot is a Kripke model for commitment. This allows us to understand the temporal operators $\Diamond$ and $\Box$ as quantifying over potential future commitment states. To define defeasible inference we modify Commonsense Entailment (Asher and Morreau, 1990) to include a temporal dimension.

Definition 8 (Point)**.** Let W be a set of worlds. A *point* on W is a model for three speaker public commitment modal logic (A, B and the Jury J), i.e. a structure $t = \langle W, V^t, R^t_A, R^t_B, R^t_J \rangle$ where V is a valuation and R^t_A, R^t_B and R^t_J are accessibility relations.

Definition 9 (Intention Model)**.** A *intention model* is a tuple $M = \langle W, P, S, T, * \rangle$ where:

- W is a set of worlds.
- P is a set of points on W.
- $S \subseteq P^{<\omega}$ is a tree. That is, $\emptyset \in S$ and S is a set of finite sequences on P such that if $x \in S$ and y is an initial segment of x, then also $y \in S$. If $x \in P^{<\omega}$, $x = \langle t_1, t_2, ..., t_n \rangle$, we write $x \oplus t = \langle t_1, t_2, ..., t_n, t \rangle$ for the extension of x with t.
- T is a function that maps an $x \in S$ and a $w \in W$ to a maximal branch in S extending x i.e. $T(x,w) \subseteq S$ is a set of finite sequences such that:
  - $x \in T(x,w)$ and for all $y \in T(x,w)$, x is an initial segment of y.
  - $\bigcup T(x,w)$ is infinite or there is no $t \in P$ such that $(\bigcup T(x,w) \oplus t) \in S$.
  - $T(x \oplus t, w) = T(x,w) \setminus \{x\}$.
- $*$ is a function $* : W \times \mathscr{P}(S \times W) \to \mathscr{P}(S \times W)$ with:

- for all $w \in W$ and $X \subseteq S \times W$, $*(w,X) \subseteq X$.
- for all $w \in W$ and $X, Y \subseteq S \times W$, $*(w, X \cup Y) \subseteq *(w,X) \cup *(w,Y)$.

For $x \in S$ write $M^x = \langle W, V^x, R^x_A, R^x_B, R^x_J \rangle$ for the last point in x.

Intuitively, S is represents possible conversations along transitions between the commitment structures P. A finite sequence represents a finite conversation and the last point in the sequence is the current commitment state in that conversation; intuitively T assigns *a future timeline* to every world in that state. Note that time at a world is linear, and the temporal modals are evaluated with respect to the same world at different points in time.

We use T to give truth-conditions to the temporal operators and $*$ to give truth-conditions to defeasible conditionals. The function $*$ assigns to a world and a set of sequence-world pairs (i.e. the extension of a proposition, computed globally on the entire tree) the set of sequence-world pairs where the proposition holds in a typical ('normal') manner.

Definition 10 (Truth)**.** Truth is defined in a model $M = \langle W, P, S, T, * \rangle$ relative to an $x \in S$.

- $M, x, w \models p$ iff $w \in V(p)$,
- $M, x, w \models \neg\varphi$ iff $M, x, w \not\models \varphi$,
- $M, x, w \models \varphi \wedge \psi$ iff $M, x, w \models \varphi$ and $M, x, w \models \psi$,
- $M, x, w \models C_S\varphi$ iff for all $v \in R^x_S(w)$, $M, x, v \models \varphi$,
- $M, x, w \models \Diamond\varphi$ iff there is a $y \in T(x, w)$ such that $M, y, w \models \varphi$.
- $M, x, w \models \varphi > \psi$ iff $\forall (y, v) \in *(w, \{(y, v) \in S \times W \mid M, y, v \models \varphi\})$, $M, y, v \models \psi$.

Write $[\![\varphi]\!] = \{(y, v) \in S \times W \mid M, y, v \models \varphi\}$ for the global extension of φ.

Note that this definition of $\Diamond$ satisfies KT4—and quite a lot more. The assumptions we have made in the preceding discussion were intentionally chosen to be minimal, *basic* assumptions. They are not *complete* for this model theory, as this would require some stronger assumptions. We leave an investigation into these for further work. Our goal here is to demonstrate that this semantic framework is expressive enough to define admissibility conditions corresponding to our basic principles.

Definition 11 (Semantic Axioms for the Basic Principles)**.** The Basic Principles correspond to the following structural axioms on intention models.

(a) $C_A\varphi > C_A\Box C_A\varphi$.

$\forall X \subseteq \mathscr{P}(S \times W),\ w \in W:$
$*(w, \{(y, v) \in S \times W \mid \forall v' \in W : vR^y_A v' \rightarrow (y, v') \in X\})$
$\subseteq \{(y, v) \in S \times W \mid \forall v' \in W \Big(vR^y_A v' \rightarrow \forall y' \in T(y, v') \big(\forall v'' \in W (v' R^{y'}_A v'' \rightarrow (y', v'') \in X) \big) \Big) \}.$

(b) $C_A\neg C_A\neg\varphi > C_A\Box\neg C_A\neg\varphi$.
$\forall X \subseteq \mathscr{P}(S\times W),\ w\in W:$
$*(w,\{(y,v)\in S\times W \mid \forall v''\in W(vR^y_A v'' \rightarrow \exists v'\in W: v''R^y_A v' \wedge (y,v')\in X)\})$
$\subseteq \{(y,v)\in S\times W \mid \forall v'\in W\Big(vR^y_A v' \rightarrow \forall y'\in T(y,v')\big(\exists v''\in W: v'R^{y'}_A v'' \wedge (y,'v'')\in X\big)\Big)\}$.

(c) $C_A\Diamond C_A\Diamond\varphi > C_A\Diamond\varphi$.
$\forall X \subseteq \mathscr{P}(S\times W),\ w\in W:$
$*(w,\{(y,v)\in S\times W \mid \forall v'\big(vR^y_A v' \rightarrow \exists y'\in T(y,v')\forall v''\in W:$
$(v'R^{y'}_A v'' \rightarrow \exists y''\in T(y',v''):(y'',v'')\in X)\big)\})$
$\subseteq \{(y,v)\in S\times W \mid \forall v'\in W\Big(vR^y_A v' \rightarrow \exists y'\in T(y,v'):(y',v')\in X\Big)\}$.

(d) $C_A\Diamond\Box(C_A\varphi \leftrightarrow C_J\varphi)$.
$\forall x\in S,\ w\in W:\ \forall v(wR^x_A v \rightarrow \exists y\in T(x,v)\forall z\in T(y,v): R^z_A = R^z_J)$.

Analogously for the axioms for speaker B.

The axioms for (a)–(c) look complicated, but are in fact just structural decodings of the truth-conditions of the Basic Principles. The soundness of (d) is trivial, and we present the soundness proof for axiom (a).

Theorem 12 (Soundness)**.** On intention models M where the axioms for (a) from Definition 11 holds: $\forall x\in S\ \forall w\in W: M,x,w \models C_A\varphi > C_A\Box C_A\varphi$.

Proof. Fix x and w. It is to show that $*(w,[\![C_A\varphi]\!]) \subseteq [\![C_A\Box C_A\varphi]\!]$. Instantiate the axiom for (a) for $X = [\![\varphi]\!]$ to obtain the sets:

$$
\begin{aligned}
&*(w,\{(y,v)\in S\times W \mid \forall v'\in W: vR^y_A v' \rightarrow (y,v')\in[\![\varphi]\!]\})\\
=&*(w,\{(y,v)\in S\times W \mid \forall v'\in W: vR^y_A v' \rightarrow M,y,v'\models\varphi\})\\
=&*(w,\{(y,v)\in S\times W \mid M,y,v\models C_A\varphi\})\\
=&*(w,\{[\![C_A\varphi]\!]\})\\
\subseteq&\{(y,v)\in S\times W \mid \forall v'\in W\Big(vR^y_A v' \rightarrow \forall y'\in T(y,v')\big(\forall v''\in W(v'R^{y'}_A v'' \rightarrow (y',v'')\in[\![\varphi]\!])\big)\Big)\}\\
=&\{(y,v)\in S\times W \mid \forall v'\in W\Big(vR^y_A v' \rightarrow \forall y'\in T(y,v')\big(\forall v''\in W(v'R^{y'}_A v'' \rightarrow M,y',v''\models\varphi)\big)\Big)\}\\
=&\{(y,v)\in S\times W \mid \forall v'\in W\big(vR^y_A v' \rightarrow \forall y'\in T(y,v')(M,y',v'\models C_A\varphi)\big)\}\\
=&\{(y,v)\in S\times W \mid \forall v'\in W(vR^y_A v' \rightarrow \forall M,y,v'\models \Box C_A\varphi)\}\\
=&\{(y,v)\in S\times W \mid M,y,v\models C_A\Box C_A\varphi\}\\
=&[\![C_A\Box C_A\varphi]\!]
\end{aligned}
$$

This is precisely the truth-condition for $C_A\varphi > C_A\Box C_A\varphi$. $\Box$

5. Conclusion

The work we have presented here is intended to be foundational. We offer an understanding of *commitment* in conversation that is grounded in the basic principles we take to be partly constitutive of the concept. Moreover, this understanding allows us to straightforwardly understand the elusive notion of *intention* without requiring additional machinery. The result is a model that goes well beyond using commitment as a mere scorekeeping device on the conversational record. By taking *public commitments* as basic observable data, we validate sophisticated inferences from *what is observed* to *what is intended*.

By conceptualising speech acts as the undertaking of particular commitments, the model then explains what illocutionary forces are and what it means to take up a speech act. We can also define the dual of uptake—cancellation—through our general account of rejection: not just as the rejection of a proposition, but as the rejection (cancellation) of an arbitrary speech act. We have demonstrated how this works for the particular case of rejecting a rejection.

Our *Basic Principles* are designed to apply in full generality to cooperative and noncooperative situations. We are able to distinguish cooperativity by modulating additional constraints on what it means to *commit*: by strengthening how tightly speakers are bound by their commitments, we can exclude particular noncooperative moves, and ultimately arrive at the result that cooperative speakers *take up what they understand* (if they can).

In future work we intend to extend this discussion to further speech acts, in particular questions. As mentioned in the Introduction, there are *prima facie* natural intuitions of what speakers *intend* when asking or replying to questions. This project, however, faces some challenges. We first need to include suitable propositional semantics for questions into our (as of yet very simple) commitment structures. Then, it is well possible that there are additional principles that constitute commitment with respect to *questions*; i.e. our Basic Principles potentially underspecify what it means to be committed to a question.

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An anti-intellectualist treatment of German *wissen* (‘know’)[1]

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Abstract. German *wissen* (‘know’) can embed both finite clauses (‘*wissen*-FIN’) as well as infinitives (‘*wissen*-INF’). Based on novel empirical observations, we argue that *wissen*-INF cannot be reduced to the standard analysis of *wissen*-FIN, i.e. that *wissen* with infinitival complements does not involve a propositional attitude. As cross-linguistic evidence suggests that German *wissen* is not ambiguous, it follows that *wissen*-FIN cannot denote a propositional attitude, either. Accordingly, we require a new, uniform meaning for *wissen*. We derive this meaning by first considering *wissen*-INF, arguing that it combines semantic properties of ability modals with semantic properties of implicative verbs and *enough to*-constructions. We then show that these properties can also be used to characterize *wissen*-FIN, as long as certain non-standard assumptions are made about the denotation of the complement. This gives us a new, unified analysis of *wissen* and also helps to explain some properties of this verb (with both kinds of complements) that traditional analyses cannot account for.

Keywords: propositional attitudes, ability modals, actuality entailments

1. Introduction

Most treatments of English *know* and analogous expressions in other languages take its occurrence with finite declarative complements as their point of departure. Our focus here will be on German *wissen* (‘know’) – its finite declarative pattern is given in (1a). In these contexts, *wissen* (‘*wissen*-DECL’) seems to express a propositional attitude, i.e. a particular relation between the referent of the matrix subject and the content of the embedded clause. More specifically, following Hintikka’s 1969 treatment of attitudes, the meaning of *wissen*-DECL involves a bipartition of the set of possible worlds – those worlds compatible with the subject referent’s belief about the world of evaluation on the one hand vs. all the others – and the subsequent evaluation of the proposition w.r.t. the belief-worlds – the proposition must hold in all of them. (Henceforth we simply write ‘x believes p in w’ for ‘p holds in all of x’s belief-worlds relative to w’). In addition to this, *wissen*-DECL is factive, i.e. it presupposes the truth of its complement (cf. Kiparsky and Kiparsky (1970)), so that we end up with the lexical entry in (1b).

(1) a. Der Frank weiß, dass der Hedde die Pommes gegessen hat.
The Frank knows that the Hedde the french-fries eaten has
‘Frank knows that Hedde ate the french fries.’ *wissen*-DECL

b. $[\![\textbf{wissen}\text{-DECL}]\!] = \lambda w_s.\ \lambda p_{\langle s,t\rangle}.\ \lambda x_e\text{: } p(w) = 1.\ x \text{ believes } p \text{ in } w$

The core insight that *wissen*-DECL denotes a propositional attitude carries over to cases where *wissen* embeds a finite interrogative (‘*wissen*-INT’), as in (2a) and (2b) (cf. Karttunen (1977)

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a.o.). Essentially, an individual can be said to *wissen*-INT a question iff it believes all the propositions that are true answers to that question in the world of evaluation. This is captured in the (simplified) lexical entry in (2c) (where $Q(w)$ is the set of true answers in w).

(2) a. Der Frank weiß, wer die Pommes gegessen hat.
The Frank knows who the french-fries eaten has
'Frank knows who ate the french fries.' *wissen*-INT

b. Der Frank weiß, ob der Hedde die Pommes gegessen hat.
The Frank knows whether the Hedde the french-fries eaten has
'Frank knows whether Hedde ate the french fries.' *wissen*-INT

c. $[\![$**wissen**-INT$]\!] = \lambda w_s.\ \lambda Q_{\langle s,\langle\langle s,t\rangle,t\rangle\rangle}.\ \lambda x_e.\ x$ believes $\bigcap Q(w)$ in w

Like many other attitude verbs, *wissen* does not only embed finite clauses as in (1) and (2) (here generalised as '*wissen*-FIN') but also infinitives, (3). The question is, how this occurrence of *wissen* ('*wissen*-INF') and its meaning relates to *wissen*-FIN and its meaning. (Note that the English paraphrase in (3) is a rough approximation and will be refined below.)

(3) Der Frank weiß sich zu verteidigen.
The Frank knows REFL to defend
'Frank is able to defend himself.'/'Frank knows how to defend himself.' *wissen*-INF

There are two general strategies to tackle this question. On the one hand, *wissen* could be taken to be ambiguous, i.e. the meaning of *wissen*-INF would be independent of that of *wissen*-FIN. Below, we will show that this assumption is implausible, as several genetically unrelated languages behave like German. On the other hand, we could maintain that the denotation of *wissen* is uniform, i.e. that *wissen*-INF and *wissen*-FIN have the same denotation. Within the latter view, we can distinguish two positions. The first one could be considered a linguistic version of what is known in the philosophical literature as the 'intellectualist' position. Stanley and Williamson (2001) and Stanley (2011) take such a view w.r.t. English *know*, which embeds both finite clauses, (4a-c) as well as *wh*-infinitives, (4d): They argue that *know* embedding *wh*-infinitives is semantically reducible to *know* with finite complements, i.e. that *know* generally denotes a propositional attitude. Applied to German, this would mean that *wissen*-INF reduces semantically to *wissen*-FIN and that *wissen* generally denotes a relation between the subject-referent and a proposition, mediated by the subject-referent's epistemic state.

(4) a. Frank knows that Hedde ate the french fries.
b. Frank knows who ate the french fries.
c. Frank knows whether Hedde ate the french fries.
d. Frank knows how to defend himself.

This paper argues that the intellectualist position is untenable for German *wissen*, and proposes an alternative analysis that is essentially 'anti-intellectualist': It maintains a uniform meaning for *wissen*, but denies that this meaning (by itself) ever involves a propositional attitude.

Our reasoning is roughly as follows: We first show that *wissen*-INF as in (3) is not reducible to a propositional attitude but rather involves semantic properties usually connected to ability modals (cf. Thomason (2005), Bhatt (2006)) and implicative verbs (cf.Karttunen (1971) a.o.): As already noted by Rumfitt (2003) for French, (3) is similar in meaning to (5) (it is not quite identical to it, as we will see below). In addition to this, *wissen*-INF also displays semantic characteristics observable in *enough-to* constructions (cf. Meier (2003), Hacquard (2005)).

(5) Frank is able to defend himself.

Since the cross-linguistic data suggest that *wissen* is not ambiguous and since *wissen*-INF does not involve a propositional attitude, *wissen*-FIN cannot do so, either, hence the standard hypotheses about its meaning in (1b) and (2c), respectively, cannot be maintained. In order to arrive at a new, unified meaning of *wissen*, we 'reverse-engineer' the meaning of *wissen*, taking our findings from *wissen*-INF and transferring them to *wissen*-FIN. Broadly speaking, we will submit that *wissen* always combines with a property of individuals *P*. In the case of *wissen*-INF, this is straightforward, but in the case of *wissen*-FIN, this requires us to make non-standard assumptions about the denotations of finite embedded declaratives and interrogatives, respectively: Building on work by Kratzer (2006) and Moulton (2015), we suggest that they denote properties of individuals, namely, the property of having factual evidence for *p* (in the case of declaratives) (or for one of the alternatives of *p*, in the case of interrogatives).

It turns out that this gives us an empirically adequate treatment of *wissen*-FIN and furthermore derives data that traditional theories, i.e. the lexical entries in (1b) and (2c), cannot account for.

2. Why *wissen*-INF is not reducible to *wissen*-FIN

The intellectualist position taken by Stanley and Williamson (2001), Stanley and Williamson (2001) w.r.t. *know* involves two core assumptions, which we here apply to German: (i) the denotation of *wissen*-FIN involves a propositional attitude, and (ii) the denotation of *wissen*-INF is reducible to that of *wissen*-FIN.[2]

The empirical motivation for this hypothesis is that – at least at first sight – sentences with *wissen*-INF are adequately paraphrased by means of sentences with *wissen*-FIN – more specifically, with *wissen*-INT: (6a), from (3) above, and (6b) seem to be semantically equivalent.

(6) a. Der Frank weiß [$_{\text{INF}}$ sich zu verteidigen]. *wissen*-INF
b. Der Frank weiß, [$_{\text{INT}}$ wie er/man sich verteidigen kann/soll].
The Frank knows how he/one REFL defend can/should
'Frank knows how he/one can/should defend him/oneself.' *wissen*-INT

Given this apparent identity, we can specify the intellectualist hypothesis: *wissen*-INF has the denotation assumed for *wissen*-INT above: It holds of a subject-referent and a question iff that subject-referent believes every true answer to the question, (7a). Since *wissen*-INF is semantically equivalent to *wissen*-INT, its infinitive complement must also have the same denotation as that of *wissen*-INT, i.e. it must denote a question - as sketched for (6) in (7b).

[2]It should be noted that Stanley (2011) explicitly refrains from making a similar point about German.

(7) a. $[\![\textbf{wissen-}\text{INF}]\!] = [\![\textbf{wissen-}\text{INT}]\!] = \lambda w_s.\ \lambda Q_{\langle s,\langle\langle s,t\rangle,t\rangle\rangle}.\ \lambda x_e.\ x$ believes $\bigcap Q(w)$ in w
b. $[\![\textbf{INF}]\!] = [\![\textbf{INT}]\!] = \lambda w.\lambda p_{\langle s,t\rangle}.\ \exists m[m$ is a technique & $p = \lambda w.$ one should use m in w for self-defence] & $p(w) = 1]$

The following will show that this intellectualist position is untenable. It predicts that both *wissen*-FIN and *wissen*-INF require their subject-referent to hold a particular belief – and nothing else (i.e. holding that particular belief is both necessary and sufficient to make the sentence true). This turns out to be descriptively adequate for *wissen*-FIN, but crucially not for *wissen*-INF: First, for a sentence of the form in (8) to be true, *a* is required to have properties other than believing the true answers to the hypothetical denotation of *P* (*qua* (7b)). Second, for such a sentence to be true, it is is not even required that *a* believes the true answers to the hypothetical denotation of *P* . In sum, holding a propositional attitude is neither sufficient nor necessary for *wissen*-INF, which falsifies the intellectualist claim.

(8) *a wissen*-INF *P*.

2.1. Propositional attitude not sufficient for *wissen*-INF

Our first point is that *wissen*-INF, as opposed to *wissen*-INT, might require 'more' than the subject-referent holding a certain belief. That is, according to the intellectualist hypothesis in (7) above, both sentences should be true in a world *w* if Frank believes all propositions in (10) – but this is not sufficient for *wissen*-INF.

(9) a. Der Frank weiß, wie er/man sich verteidigen kann/soll.
The Frank knows how er/one REFL defend can/should
'Frank knows how he/one can/should defend him/oneself.' *wissen*-FIN
b. Der Frank weiß sich zu verteidigen. *wissen*-INF

(10) $\{p : \exists m[m$ is a technique $\& p = \lambda w.$ one should use m in w for self-defence$]\& p(w) = 1\}$

In particular, *wissen*-INF in (9b) requires a more 'practical acquaintance' with defence techniques than *wissen*-INT in (9a): A situation where Frank is aware of what the proper techniques of self-defence are, but has never tried to defend himself is adequately described by (9a) but not by (9b): Adding the continuation in (11) to (9a) gives us a well-formed discourse, but if we add it to (9b), the result is extremely odd.[3]

(11) ??Er hat es zwar noch nie versucht, aber die Viola hat es ihm genau erklärt.
'He has never tried it, but Viola explained to him in detail how it works.'

Accordingly, theoretical knowledge – believing the propositions in the complement's presumed denotation – is sufficient for the truth of a sentence with *wissen*-FIN, but not for a sentence with *wissen*-INF. This runs contrary to the predictions of the intellectualist position.

[3]Stanley and Williamson (2001) make similar observations concerning *know* + *wh*-infinitives.

2.2. Propositional attitude not necessary for *wissen*-INF

Our second point is that *wissen*-INF, as opposed to *wissen*-INT, does not even require the subject-referent to hold a certain belief. According to the intellectualist hypothesis, both (12a) and (12b) should be true in a world *w* iff our friend believes every proposition in (13). Yet sentences with *wissen*-INF can be adequate descriptions of situations where the subject-referent holds no such belief: In (12), the context specifies that our friend is agnostic about drinking techniques. Whereas (12a) is very odd, in this context, to say the least, (12b) is perfectly fine. Again, this runs contrary to the predictions of the intellectualist position.

(12) Ich habe unseren neuen Freund aus Pennsylvania mit auf's Feuerwehrfest genommen. Es war unglaublich – er hatte noch nie von Alkohol gehört aber ich kann Dir sagen:'
'I took our new friend from Pennsylvania with us to the party of the local fire department. It was unbelievable – he had never even heard of alcohol, but I can tell you:
a. ??Der Mann weiß, wie er/man trinken kann/soll.
the man knows how he/one drink can/should
'This man knows how he/one can/should drink.' *wissen*-FIN
b. Der Mann weiß zu trinken.
The man knows to drink *wissen*-INF

(13) $\{p\colon \exists m[m \text{ is a technique } \& p = \lambda w. \text{ one should use } m \text{ in } w \text{ for drinking}] \& p(w) = 1\}$

The following data provide even stronger evidence for the same point: *wissen*-FIN does not license inanimate subjects, as illustrated by (14a) and (15a). If *wissen*-FIN involves a propositional attitude, the reason is obvious: Inanimate individuals cannot entertain beliefs. However, *wissen*-INF may combine with inanimate subjects, as witnessed by (14b) and (15b).

(14) a. #Ihre Stimme weiß, wie man das Publikum fesseln kann/soll.
Her voice knows how one the audience enthral can/should
'Her voice knows how one can/should enthral the audience.' *wissen*-FIN
b. Ihre Stimme weiß das Publikum zu fesseln
Her voice knows the audience to enthral
'Her voice is able to enthral the audience.' *wissen*-INF

(15) a. #Dieses Produkt weiß, wie man Leute überzeugen kann/soll.
This product knows how one people convince can/should
'# This product knows how can can/should convince people. ' *wissen*-FIN
b. Dieses Produkt weiß zu überzeugen.
This product knows to convince
'This product is able to convince people / is convincing' *wissen*-INF

Accordingly, whereas *wissen*-FIN requires its subject-referent to entertain beliefs, *wissen*-INF does not, which shows that the meaning of *wissen*-INF cannot involve a propositional attitude.[4]

[4]One could object that (14b) and (15b) involve coercion (of the subject or the verb). However, this begs the question why, if *wissen*-INF and *wissen*-INT are semantically identical, coercion is only easily available for

2.3. Interim summary

The previous paragraphs have shown that *wissen*-INF is not reducible to the meaning traditionally assigned to *wissen*-FIN: Attributing a propositional attitude to the subject-referent is neither sufficient nor necessary for a sentence with *wissen*-INF to be true. We are left with two questions: First, what is the meaning of *wissen*-INF? And second, does it bear any relation to the meaning of *wissen*-FIN? The next section addresses the first question.

3. *wissen*-INF: ability and quality

At first sight, ability modals, such as English *able* and German *können* ('can, be able') and *in der Lage sein* ('be able') provide an adequate paraphrase for *wissen*-INF (cf. Rumfitt (2003) for French). Our example from (3) above, repeated in (16a), and the modal sentences in (16b) more or less convey the same meaning. The same holds for (17a) with an inanimate subject, repeated from (14b) above: It is roughly identical in meaning to the sentences in (17b).

(16) a. Der Frank weiß sich zu verteidigen.
b. Der Frank ist in der Lage zu / kann tanzen.
The Frank MOD to / MOD dance.
'Frank is able to dance.'

(17) a. Ihre Stimme weiß das Publikum zu fesseln.
b. Ihre Stimme ist in der Lage / kann das Publikum (zu) fesseln.
Her voice MOD / MOD the audience (to) enthral.
'Her voice is able to enthrall the audience.'

So, does *wissen*-INF have the same denotation as an ability modal? This hypothesis would not only be attractive in terms of its simplicity, but also because it would provide an obvious explanation for the data discussed in section 2.2, including the facts about inanimate subjects: ability modals don't impose any requirements on the sentence's subject-referent in terms of intentionality (but cf. Kratzer (1981) for more discussion).

We will show that the situation is slightly more complex. *wissen*-INF does indeed share several semantic traits with ability modals (in particular, with the English *be able*, Bhatt (2006) and Hacquard (2006, 2010, ta)): So-called actuality entailments and what we here call '*P*-event-intiation', namely, that the subject-referent causes an event that is intended to be an event of the kind specified by the complement (the latter is henceforth referred to as '*P*'). However, it also exhibits two meaning components that ability modals arguably lack: A 'quality-threshhold', namely, the requirement that the subject-referent be good at *P* and the condition that it must be compatible with the facts of the evaluation world that some individual is *P*.

wissen-INF. It also doesn't explain cross-linguistic differences in the infinitival patterns (see below).

3.1. Actuality entailments

As observed by Bhatt (2006) and Hacquard (2014) for English and French, ability modals with an episodic past / perfective ascpect come with actuality entailments, i.e., from the truth of '*x* abil-modal *P*' at some point in the past it can be concluded that '*x P*' is true at that point in the past. This also holds for the German modal *können* on an ability reading, as shown in (18).[5]

(18) Im Endspiel konnte der Frank das Tor treffen.
In-the final can-PAST the Frank the goal hit.
'In the final, Frank was able to score a goal.' ⇝ *In the final, Frank scored a goal*

This pattern carries over to *wissen* ('know') + INF: a sentence like (19a) with an episodic past / perfective ascpect cannot be continuated by (19b) since this would contradict the actuality entailment of (19a).

(19) a. Bei ihrem letzten Mittagessen wusste der Frank den Hedde abzulenken.
at their last lunch knew the Frank the Hedde to-divert.
'During their last lunch, Frank was able to divert Hedde.'
b. #Er hat es aber dann doch nicht gemacht, weil er ein schlechtes Gewissen hatte.
'But he didn't actually do it, because he felt bad.'

In contrast to the observations by Bhatt (2006), Hacquard (2014) for English and French, we even find 'unspecific' actuality-entailments for ability modals in German with a generic past or present / imperfective aspect.

(20) Ja, früher, da konnte der Frank das Tor treffen.
Yes, in-those-days, EXPL can-PAST the Frank the goal hit.
'Well, in those days, Frank was able to score a goal.'
⇝ *At some point in the past, Frank scored a goal.*

We call these entailments 'unspecific' since there is no particular point in the past for which it has to be true that *x P*'s as long as there *is* such a point for which it is true. Again, the same can be observed for *wissen* ('know') + INF with a generic past or present / imperfective aspect:

(21) Ja, früher, da wusste der Frank zu tanzen – #er hat es zwar nie
Yes, in-the-old-days, EXPL knew the Frank to dance – he has it PRT never
gemacht, aber es wäre ihm ein Leichtes gewesen.
done but it would-have him an easy-thing been
'In the old days, Frank had the ability to dance – although he never did it, it would have been easy for him.'

These entailments have to be taken care of by the assertive component, since the entailments, as with ability modals, disappear under negation, see (22).

[5] In German, there is no overt marking of aspect. Nonetheless, we are assuming a semantic feature corresponding to perfective aspect for German, see Kratzer (1998) for a discussion.

(22) Der Frank wusste den Hedde nicht abzulenken
the Frank knew the Hedde not to-divert.
$\not\rightsquigarrow$ *Frank diverted Hedde's attention.*

3.2. *P*-event initiation

Ability modals furthermore require that their subject-referent is conceptualized as the causer of the *P*-event (cf. related discussion in Bhatt (2006)).The decomposed lexical meaning of ‘*P*’ in ’*x* abil-modal *P*’ must contain a CAUSE-relation – otherwise the assertion is odd, as in (23).

(23) #Der Frank kann besorgt sein
The Frank can worried be
#‘Frank is able to be worried.’ BE

This property can also be observed for *wissen* (‘know’) + INF: While the examples in (24a) and (24b) take a predicate as their argument that introduces a CAUSE-relation, the example in (24c) with a predicate that doesn't involve a CAUSE-relation is as odd as (23).

(24) a. *Der Frank* **weiß** *ein Gedicht vorzutragen.*
The Frank knows a poem to-recite
‘Frank is able to recite a poem.’ CAUSE(BEC(BE))
b. *Ihre Stimme* **weiß** *zu fesseln.*
Her voice knows to enthrall
‘Her voice is able to enthral the audience.’ CAUSE(BEC(BE))
c. #*Der Frank* **weiß** *besorgt zu sein.*
The Frank knows worried to be BE

Crucially, the *P*-event has to be intended by someone to be a *P*-event. This is what goes wrong in (25), where the unintended outcome is highlighted by the adverb *zufällig* (‘by chance’).

(25) #Der Frank ist gestolpert und wusste dadurch zufällig den Hedde abzulenken.
The Frank is tripped and knew thereby by-chance the Hedde to-divert
‘Frank tripped and, by chance, WUSSTE thus to distract Hedde’

Again, we find a parallel for ability ascriptions with *fähig sein* (‘be able’) in (26).

(26) #Der Frank ist gestolpert und war dadurch zufällig fähig den Hedde abzulenken.
The Frank is tripped and was thereby by-chance able the Hedde to-divert
‘?Frank tripped and, by chance, was thus able to distract Hedde.’

The negated sentence in (27) has the same entailments – the subject-referent is the causer of an event and that has to be intended as a *P*-event – which indicates that the entailments are presuppositions of *wissen*+ INF. Accordingly, we conclude, as a first step, that *wissen*-INF presupposes the subject-referent to make an effort/try to *P*. This is in analogy for Bhatt's 2006 claims for *able*, which he directly relates to the behavior of implicative verbs such as *manage* discussed by Karttunen (1971); Karttunen and Peters (1979) (cf. also Thomason (2005)).

(27) #Der Frank ist zufällig gestolpert. Es war nicht der Fall, dass er dadurch den
The Frank is by-chance tripped. It was not the case that he thereby the
Hedde abzulenken wusste.
Hedde to-divert knew
'Frank tripped by chance. It was not the case that he thereby WUSSTE to distract Hedde'

However, the situation is complicated by the fact that examples like (17a) above showed that *wissen*-INF licenses inanimate subjects: An inanimate subject-referent cannot try/make an effort to *P*, yet we get the same intuition, namely, that there must be an intention for the subject-referent to *P* – even if it is not the subject-referent's own intention. This is shown by the fact that the discourse in (28) seems incoherent.

(28) #Komparsin Gerda fiel während der Aufführung hin und stieß aus Versehen
Extra Gerda fell during the performance PRT and pushed inadvertently
einen Schmerzensschrei aus. Ihre Stimme wusste das Publikum (nicht) zu begeistern.
a scream-of-pain PRT her voice knew the audience (not) to enthrall
INTENDED: 'Extra Gerda fell down during the performance and inadvertently gave a yelp of pain. Her voice was (not) able to enthral the audience.'

So the correct generalisation is that *wissen*-INF requires the subject-referent to cause some event that *someone* intends to be a *P*-event.

3.3. The quality threshold

So far, we have determined that *wissen*-INF, just like ability modals, gives rise to actuality entailments and, analogous to ability modals and implicative verbs, requires a *P*-event initiation. However, there is one aspect of *wissen*-INF that sets it apart from (German) ability modals (but cf. Bhatt (2006) for a related discussion of *able*): It requires the subject-referent to be good at (doing) *P*, where *P* is the property expressed by the complement. In other words, there is an intuitive difference between (29b), with *wissen*-INF and (29a), with ability modals: (29b) conveys that Frank is especially good at swimming in some respect – depending on the context, this might relate to endurance, or style or artistic versatility – but the examples (29a) don't.

(29) a. Der Frank kann schwimmen / is in der Lage zu schwimmen.
the Frank can swim / is in the position to swim.
'Frank is able to swim'
b. Der Frank weiß zu schwimmen.
the Frank knows to swim.

This intuition is corroborated by the contrast in (30): With ability *können* ('can'), a continuation that explicitly denies the subject-referent being good at *P* is fine, (30a), but with *wissen*-INF, such a continuation is definitely odd, as witnessed by (30b).

(30) a. Naja, der Frank kann schon schwimmen. Er ist zwar nicht wahnsinnig gut,
Well the Frank can PRT swim. He is PRT not extremely good,
aber er schafft es, 20 Bahnen durchzuhalten.
but he manages it 20 laps to-hang-on
'Well, Frank can swim. He might not be particularly good at he, but he manages to do 20 laps.'

b. Naja, der Frank weiß schon zu schwimmen. #Er ist zwar nicht wahnsinnig
Well the Frank knows PRT to swim. He is PRT not extremely
gut, aber er schafft es, 20 Bahnen durchzuhalten.
good, but he manages it 20 laps to-hang-on

In other words, *wissen*-INF behaves more or less analogously to constructions with ability modals + modification by *gut* ('good'). This parallel becomes evident once we look at predicates that one can be 'good at' only in a very peculiar way. Consider for instance (31a) with an ability modal: Without *gut*, the sentence can be used to express pure dispositional possibility. Adding *gut* immediately gives us a reading where we are talking about a particular skill. As breathing is usually considered something that comes naturally – i.e. does not require a particular design (granted you are a mammal) or technique, the result is odd – unless, of course, it is used in a context where special breathing techniques are required, such as a yoga class. The sentence in (31b) is analogous to (31a) with *gut*-modification: It is only appropriate in yoga-type contexts, i.e. contexts where breathing involves a particular skill.

(31) a. Frank kann (#gut) atmen.
Frank can (well) breathe
'Frank is able to breathe well'

b. #Frank **weiß** zu atmen.
Frank knows to breathe

In sum, *wissen*-INF, compared to ability modals, exhibits an additional requirement: That the subject-referent be 'good' at the complement property *P*. We henceforth refer to this as as the 'quality threshold' of *wissen*-INF. Just as *P*-event initiation, the quality threshold can be shown to be part of the presuppositional, rather than the assertive component of *wissen*-INF: When negating *wissen*-INF *P*, we don't only negate that the subject-referent is good at (doing) *P* (but is still able to do *P*), as witnessed by the fact that (32) is extremely odd:

(32) #Naja, der Frank weiß nicht zu tanzen, aber er kann es schon etwas.
Well the Frank knows not to dance, but he can it PRT a-little
'Well, Frank doesn't *wissen* to dance but he can dance a little'

3.4. Circumstantial possibiliy

Another trait that sets *wissen*-INF apart from ability modals such as *können* ('can, be able') and *in der Lage sein* ('be able') is that sentences with *wissen*-INF require that having the property *P* must be compatible with the facts of the world. Put differently: *wissen*-INF requires the facts of the world to be compatible with some individual being *P*. (Cf. Kratzer's 1981 discussion of 'circumstantial' possibility' in this respect.) This particular property of *wissen*-INF is reflected in (33) and (34): In both examples, the possibility of someone being *P* is explicitly denied. Whereas it is fine to negate 'abil-modal *P*' in this context, as shown by (33a) and (34a), it is extremely odd to negate *wissen*-INF *P* in the same context.

(33) a. Es ist generell so, dass Menschen nicht fliegen können.
It is generally thus that humans not fly can
'It is generally the case that humans are not able to fly.'
b. #Es ist generell so, dass Menschen nicht zu fliegen **wissen**.
It is generally thus that humans not to fly know

(34) a. Wenn die Riemann'sche Vermutung, nicht beweisbar ist, kann auch der Frank sie nicht beweisen.
If the Riemann conjecture not provable is can also the Frank it not prove
'If Riemann's conjecture is unprovable, Frank won't be able to prove it.'
b. #Wenn die Riemann'sche Vermutung, nicht beweisbar ist, **weiß** auch der Frank sie nicht zu beweisen.
If the Riemann conjecture not provable is knows also the Frank it not to prove

In other words: If it is generally impossible for any individual to *P*, we cannot negate *a wissen*-INF *P*: This shows, that *wissen*-INF presupposes the circumstantial possibility that some individual is *P*.

3.5. Interim summary

In the preceding paragraphs, we tried to isolate the different meaning components of *wissen*-INF. We first showed that *wissen*-INF, just like ability modals, involves actuality entailments: Depending on its aspectual properties, a sentence *a wissen*-INF *P* has a specific actuality entailment ('*a* did *P* at point *t*') with perfective aspect and an unspecific actuality entailment ('at some point *t*, *a* did *P*') with imperfective. We argued that this meaning component must be asserted, as it does not survive under negation. As opposed to this, the three other components we identified must be presupposed, as they cannot be explicitly negated: The *P*-event initiation, i.e. that the subject-referent must cause an event someone intends to be a *P*-event, the quality-threshold, i.e. the intuition that some particular 'skill' is required for *a* to count as *P*, and circumstantial possibility, namely, that it must be compatible with the facts of the world that some individual is *P*. This is summarized in the following table:

a is *P*	actuality entailment	**asserted**
a causes an event that is intended by someone as a *P*-event	*P*-event initiation	**presupposed**
the threshold for *a* being *P* is high	quality threshold	**presupposed**
it is compatible with the circumstances of *w* that some individual is *P*	circumstantial possibility	**presupposed**

a wissen-INF *P*

The next section aims at deriving these empirical observations.

4. The proposal

On the syntactic side, we assume that *wissen*-INF is a restructuring verb that shares properties with control and raising verbs. This is in agreement with common assumptions in the syntactic literature on German inifinitival embedding verbs, see Reis (2001), Haider (2010), but is not motivated here for reasons of space. For a sentence like (35a), we assume a structure like in (35b).

(35) a. … dass der Frank zu trinken **weiß**
… that the Frank to drink knows

b. [$_{\text{TP}}$ Frank [$_{\text{T'}}$ [$_{\text{AspP}}$ [$_{\text{VP}}$ t [$_{\text{V'}}$ [$_{v\text{P}}$ PRO [$_{v'}$ zu-trinken AGENT]] weiß-INF]] IMPERF] PRES]]

Tracking the results of the previous section, we distinguish four parts of our proposal for the semantics of *wissen*-INF.

First, the assertive component: *wissen* predicates the denotation of the infinitival complement of its matrix subject-referent, (36). This – together with certain assumptions about the interpretation of AspP (see (39) – (44) below) accounts for the actuality entailments in case of a non-negated assertion.

(36) $[\![\textbf{wissen}]\!]^c = \lambda w_s.\ \lambda P_{\langle s,\langle e,\langle v,t\rangle\rangle\rangle}.\ \lambda x_e.\ \lambda e_v.\ P(w)(x)(e)$ prefinal

Second, *wissen* presupposes the initiation of an action with the individual denoted by the matrix subject as the agent. We assume there to be an initial part of the main event that is intended by someone – typically the agent – to be an event of the type denoted by the embedded predicate, (37). This accounts for the fact that unintended events don't qualify as abilities in the relevant sense for *wissen*.

(37) $[\![\textbf{wissen}]\!]^c = \lambda w_s.\ \lambda P_{\langle s,\langle e,\langle v,t\rangle\rangle\rangle}.\ \lambda x_e.\ \lambda e_v$: there is an $e' <_{\text{init}} e$ such that x causes e' and someone intends e' to become a P-event in s. $P(w)(x)(e)$ prefinal

Third, *wissen* presupposes that the situation in which the event is initiated requires of the agent a minimal degree of performance-quality for the initiated event to become a *P*-event: it has to be considerably higher than the maximal degree of performance quality of any stereotypocal *P*-

degrees of performance quality in R_c

$$\text{————}\text{-}\underbrace{[//////////]}_{I}\text{——}\underset{d_{\min}}{|}\text{——}>$$

I = the interval such that all the maximal degrees of performance quality in the contextually relevant respect R_c of any stereotypical P-event lie in I in w

Figure 1: quality-threshhold

event, as illustrated in figure 1. This part of the meaning combines aspects of the semantics of *enough to*-constructions, see Meier (2003), and the semantics of *very*, see von Stechow (2009). Reference to requirements by the situation highlights the factual modality of *wissen*-INF which is close in spirit to the factual modality of modals following Kratzer (2013). (38) gives the final version of the lexical entry for *wissen*-INF.

(38) $[\![\textbf{wissen}]\!]^c = \lambda w_s.\ \lambda P_{\langle s,\langle e,\langle v,t\rangle\rangle\rangle}.\ \lambda x_e.\ \lambda e_v$: there is a situation $s \leq w$
   a. x **initiates** P**:** there is an $e' <_{\text{init}} e$ such that x causes e' and someone intends e' to become a P-event in s
   b. s **requires skill:** the minimal degree $d_{\min}$ of performance-quality in the contextually relevant respect R_c required by s in w for e' to become a P-event is considerably higher than the maximal degree of performance-quality in the contextually relevant respect R_c of any stereotypical P-event in w.
   $P(w)(x)(e)$ final

Note that the last aspect of the semantics, the circumstantial possibility, is not explicitly represented in (38). The basic idea is that there only is a minimal degree of performance-quality required by the situation of an agent, if all the other circumstantial requirements are already satisfied, i.e, we assume as a part of the conversational background a hierarchy of circumstantial requirements that culminate in the situational requirements of the agent with respect to his performance. Following this logic, the presupposition of there being a quality-threshold for the agent presupposes that all other circumstantial requirements are already met.

Here are two examples illustrating the interaction of (38) with Perfective (39) and Imperfective Aspect (42).

(39) a. Frank **wusste** zu trinken.
   Frank knew to drink
   b. [$_{\text{T'}}$ [$_{\text{AspP}}$ [$_{\text{VP}}$ Frank [$_{\text{V'}}$ [$_{v\text{P}}$ PRO [$_{v'}$ zu-trinken AGENT]] wußte]] PERF] PAST]

(40) a. $[\![\textbf{zu-trinken}]\!]^c = \lambda w_s.\ \lambda e_v.\ \text{drink}(e)(w)$
   b. $[\![\text{PERF}]\!]^c = \lambda w_s.\ \lambda P_{\langle v,t\rangle}.\ \lambda t_i\text{: } D_c \subseteq \text{dom}(P).\ \exists e \in D_c.\ (\text{time}(e) \subseteq t \wedge P(e))$, where $D_c \neq \varnothing$
   c. $[\![\text{PAST}]\!]^c = \lambda w : c \text{ provides time } t \leq t_c.\ t$
   d. $[\![\text{AGENT}]\!]^c = \lambda w.\ \lambda P_{\langle v,t\rangle}.\ \lambda x_e.\ \lambda e_v.\ \text{agent}(x)(e)(w) \wedge P(e)$

(41) $[\![(39b)]\!]^c = \lambda w_s$: c provides time $t \leq t_c \wedge D_c \subseteq \{e$: there is a situation $s \leq w$ such that there is an $e' <_{\text{init}} e$ and Frank causes e' and someone intends e' to become a drinking-event in $s \wedge$ the minimal degree $d_{\min}$ of performance-quality in the contextually relevant respect R_c required by s in w for e' to become a drinking-event is considerably higher than the maximal degree of performance quality in the contextually relevant respect R_c of any stereotypical drinking-event in $w\}$. $\exists e \in D_c$. (time$(e) \subseteq t \wedge$ agent(Frank)$(e)(w) \wedge$ drink$(e)(w))$

(42) a. Frank **wusste** zu trinken.
Frank knew to drink
b. $[_{\text{T'}}$ $[_{\text{AspP}}$ $[_{\text{VP}}$ Frank $[_{\text{V'}}$ $[_{v\text{P}}$ PRO $[_{v'}$ zu-trinken AGENT]] weiß]] IMPERF] PAST]

(43) $[\![\text{IMPERF}]\!]^c = \lambda w_s.\ \lambda P_{\langle v,t\rangle}.\ \lambda t_i$: $D_c \subseteq \text{dom}(P)$. GEN $e \in D_c$. (time$(e) \approx t \rightarrow P(e))$, where $D_c \neq \varnothing$

(44) $[\![(42b)]\!]^c = \lambda w_s$: c provides time $t \leq t_c \wedge D_c \subseteq \{e$: there is a situation $s \leq w$ such that there is an $e' <_{\text{init}} e$ such that Frank causes e' and someone intends e' to become a drinking-event in $s \wedge$ the minimal degree $d_{\min}$ of performance-quality in the contextually relevant respect R_c required by s in w for e' to become a drinking-event is considerably higher than the maximal degree of performance quality in the contextually relevant respect R_c of any stereotypical drinking-event in $w\}$. GEN $e \in D_c$. (time$(e) \approx t \rightarrow$ (agent(Frank)$(e)(w) \wedge$ drink$(e)(w)))$

5. A unified analysis of wissen-INF and wissen-FIN

Our discussion led to a new semantics for *wissen*-INF that is incompatible with the standard semantics of *wissen*-FIN. Does this mean that *wissen* is ambiguous? After all, *wissen*-FIN seems like a well-behaved attitude verb – its meaning thus bears no evident semantic connection to the meaning just proposed for *wissen*-INF.

The answer is: no, as the pattern discussed above is not an idiosyncratic property of German. Several other languages exhibit the same pattern, including dialects of Syrian Arabic (Peter Hallman, pc), south-western Slavic languages (Hagen Pitsch, pc, Moreno Mitrovič, pc), Romanian (Edgar Onea, pc) and Hungarian, which we use in (45) for illustration (the examples were provided by Dora Kata Takacz).

(45) a. Frank **tudja** hogy Hedde megette a sült krumplit.
Frank knows that Hedde up-ate the french fries
'Frank knows that Hedde ate the french fries.' FIN
b. Frank **tudja** hogy ki ette meg a sült krumplit.
Frank knows that who ate up the french fries
'Frank knows who ate the french fries.' FIN

(46) a. Frank el **tudja** terelni Hedde figyelmét.
Frank PRT knows to-distract Hedde attention.his.ACC
'Frank is able to distract Hedde.' INF

b. Az autó **tudte** lelkesíteni.
the car knew to-make-enthusiastic
'The car was able to /made people enthusiastic.' INF

Accordingly, the crucial question is: Can we expand our analysis for *wissen*-INF to *wissen*-FIN? For this to work, we would have to assume that *dass*-complements to *wissen*-FIN share the semantic type that corresponds to the embedded infinitivals under *wissen*-INF, see the schematic tree in (48) for the example in (47).

(47) Der Frank **weiß**, dass es regnet.
the Frank knows that it rains
'Frank knows that it is raining'

(48)
- V' $\langle s,\langle e,\langle v,t\rangle\rangle\rangle$
  - CP $\langle s,\langle e,\langle v,t\rangle\rangle\rangle$
    - dass $\langle s,\langle\langle s,t\rangle,\langle e,\langle v,t\rangle\rangle\rangle\rangle$
    - TP $\langle s,t\rangle$
      - es regnet
  - weiß $\langle s,\langle\langle s,\langle e,\langle v,t\rangle\rangle\rangle,\langle e,\langle v,t\rangle\rangle\rangle\rangle$

In the spirit of recent proposals for the semantics of complementizers (Kratzer (2006), Moulton (2015)), we propose the following meaning for *dass* in (49). (An analogous treatment can be given for interrogative complementizers, which would involve existential quantification over the alternatives of p.)

(49) $[\![\textbf{dass}]\!]^c = \lambda w_s.\ \lambda p_{\langle s,t\rangle}.\ \lambda x_e.\ \lambda e_v.$ there is a situation s such that $p(s) = 1 \wedge$ experiencer$(x)(e)(w) \wedge$ acquainted$(s)(e)(w)$

(51) gives the fully spelled out details for the example in (50).

(50) a. Der Frank **wusste**, dass es regnet.
the Frank knew that it rains
'Frank knew that it was raining'
b. [$_{\text{T'}}$ [$_{\text{AspP}}$ [$_{\text{VP}}$ Frank [$_{\text{V'}}$ [$_{\text{CP}}$ dass es regnet] weiß]] PERF] PAST]

(51) $[\![(50\text{b})]\!]^c = \lambda w_s$: c provides time $t \leq t_c \wedge D_c \subseteq \{e$: there is a situation $s \leq w$ such that there is an $e' <_{\text{init}} e$ such that Frank causes e' and someone intends e' to become an acquaintance-event in $s \wedge$ the minimal degree $d_{\min}$ of performance-quality in the contextually relevant respect R_c required by s in w for e' to become an acquaintance-event is considerably higher than the maximal degree of performance-quality in the contextually relevant respect R_c of any stereotypical acquaintance-event in $w\}$. $\exists e \in D_c$. (time$(e) \subseteq t \wedge$ there is a situation s such that $p(s) = 1 \wedge$ experiencer(Frank)$(e)(w)$ $\wedge$ acquainted$(s)(e)(w)$)

The resulting semantics is very close in spirit to the semantics for *wissen*-FIN in Kratzer (1989), Kratzer (2002) and inherits its advantages (for example in dealing with the Gettier-cases). The factivity of *wissen* follows from an interplay of the presupposition of *wissen* and the contribution of the complement: the existence of a fact is part of the circumstantial requirements that need to be satisfied so that there can be a minimal degree of performance-quality required of the agent by the situation. Or to put it in different words: the circumstantial possibility for the agent to be able to recognize the fact presupposes the settledness of the matter. Another neat property of the proposal is that it nicely meets the intution that the use of *wissen* presupposes a high degree of certainty on part of the subject-referent. This is accounted for by the quality-threshold.

There is another at first sight puzzling piece of data that we want to mention in this connection. First, note that ability modals in German can be modified with *besser* (‘better’), see (52).

(52) Die Viola **kann** den Hedde **besser** ablenken als der Frank.
the Viola can the Hedde better distract than the Frank
‘Viola is better at distracting Hedde than Frank’

Again, this is also true for *wissen*-FIN, see (53).

(53) Die Viola **weiß** den Hedde **besser** abzulenken als der Frank.
the Viola knows the Hedde better to-distract than the Frank
‘Viola has a better ability to distract Hedde than Frank.’

On our account, the explanation is straightforward since *besser* (‘better’) semantically combines with the *P*-event as the asserted part of the meaning. The more interesting aspect of the *besser* (‘better’) modification is the fact that a modification with *besser* (‘better’) is also possible with a finite complement, see (54).

(54) Der Frank **weiß**, dass der Hedde gefährlich ist, aber die arme Viola **weiß** es noch
The Frank knows that the Hedde dangerous is but the poor Viola knows it PRT
viel **besser**.
much better
‘Frank knows that Hedde is dangerous, but poor Viola knows it even better.’

On the proposed account, the *P*-event that gets modified with *besser* (‘better’) is the event introduced by the *dass*-complement which is an acquaintance-event: *besser wissen, dass* is understood as ‘being better acquainted with’ which matches our intuitions about the truth conditions of these examples. Notice that an intellectualist analysis with reference to a believe-relation would have problems in explaining examples of this type since *glauben* (‘believe’) in German cannot be modified with *better* (‘besser’), see (55).

(55) #Der Frank **glaubt**, dass der Hedde gefährlich ist, aber die arme Viola **glaubt** es
The Frank believes that the Hedde dangerous is but the poor Viola believes it

noch viel **besser.**
PRT much better
#'Frank believes that Hedde is dangerous, but poor Viola believes it even better.'

6. Summary and outlook

In this paper, we discussed two types of *wissen* ('know') in German: *wissen*-FIN and *wissen*-INF. We presented new data showing that *wissen*-INF cannot be reduced semantically to *wissen*-FIN. A closer look at the data revealed that *wissen*-INF combines semantic properties of ability modals with semantic properties of implicative verbs and *enough to*-constructions. Since the German pattern is found in a wide range of genetically unrelated languages, we argued against an ambiguity-analysis of *wissen* that assumes two different lexical entries for *wissen*-FIN and *wissen*-INF. Starting from *wissen*-INF, we showed how a semantics for *wissen*-FIN can be derived that maintains all the advantages of the standard analysis, if we make certain non-standard assumptions about the denotation of the complement clauses in *wissen*-FIN-constructions. The resulting proposal gives us a new, unified analysis of *wissen* and also helps to explain some properties of this verb (with both kinds of complements) that traditional analyses cannot account for.

It should be noted that our discussion had a very narrow focus, concentrating on German *wissen*. However, *wissen* is not the only verb that selects for both finite and infinitival complements and it is still an open question how our claims here relate to these other cases, which, at least at first sight, show a different behavior (cf. Karttunen (1971) for analogous cases in English). Take for instance *glauben* ('believe'): It can occur with both types of complements, (56), but as opposed to *wissen*, there is no obvious semantic difference between the two patterns.

(56) Der Frank glaubt [$_{\text{FIN}}$ dass er sich verteidigt] / [$_{\text{INF}}$ sich zu verteidigen].
The Frank believes [$_{\text{FIN}}$ that he REFL defends] / [$_{\text{FIN}}$ REFL to defend]
'Frank believes that he is defending himself.'

Another open question is how our claims relate to languages where its lexical correlate does not display the behavior of German *wissen* – English being a particular prominent case (cf. Stanley and Williamson (2001), Stanley (2011)): Neither the pattern with *wh*-infinitives, (57a), nor the one with bare infinitives, (57b), is parallel to German *wissen*-INF. For instance, they don't license inanimate subjects, nor can they consistently be paraphrased by sentences with ability modals: (57b) and (57c) clearly differ in meaning.

(57) a. Frank/# Frank's voice knows how to enthral the audience.
b. Frank/# Frank's car knew to leave.
c. Frank was able to leave.

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Perspectival reflexives and event semantics[1]

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Abstract. This paper presents a unified semantic theory of long-distance reflexivity inside and outside of indirect discourse. Long-distance reflexives are argued to be discourse anaphors with presuppositional restrictions to (shifted) perspective holders. Perspective-shift is analyzed in the event semantics: In indirect discourse, the perspective is assigned to the agent/experiencer of the attitudinal event. By modelling the analysis in the event semantics instead of the modal semantics of indirect discourse, it is possible to generalize it to non-attitudinal cases of long distance binding, using other event types and thematic roles.

Keywords: long-distance reflexives, indirect discourse, perspective shift, anaphora.

1. Introduction

This paper discusses the semantics of long-distance reflexives (LDRs), reflexive pronouns with antecedents outside of their minimal clause. A typical environment where LDRs are found, is in indirect discourse. The Latin example in (1) illustrates this:

(1)	*Rogatus*	*sum*	*a*	…	*matre$_i$*	*tua*	…	*[ut*	*venirem*	*ad*	*se$_i$]*
	asked.PTCP	is.1SG	by		mother	your		that	come.PST.SBJV.1SG	to	REFL.ACC

‘I was asked by your mother$_i$ to come to her$_i$’ (Cic. ad Brut. 24.1; Menge, 2000: p. 127)

LDRs in Latin are particularly frequent in indirect discourse, where they refer to the the attitude holder (AH), the individual whose propositional attitude the indirect discourse expresses (Fruyt, 1987; Solberg, 2011; Jøhndal, 2012: chap. 4).[2] The AH is often, but not necessarily, a subject. Non-subject-orientation is exemplified in (1), where the LDR antecedent is in an agentive PP of a passivized speech predicate. LDRs with this behaviour are attested in several languages in addition to Latin, such as Japanese (Iida, 1996; Oshima, 2007; Nishigauchi, 2014), Mandarin (Huang and Tang, 1991; Huang and Liu, 2001), Icelandic (Maling, 1984; Sells, 1987; Sigurðsson, 1990) and Tamil (Sundaresan, 2012).

LDRs are also attested in certain non-attitudinal environments, as in the Latin sentence in (2), where an LDR occurs in a complement to *deserve* and refers to the subject of that predicate:[3]

[1]I would like to thank my supervisors Dag Haug and Corien Bary, the very constructive SuB reviewers, and my audience in Edinburgh, in particular Jefferson Barlew and Amy Rose Deal.

[2]I use *propositional attitude* in a wide sense, covering both mental states and utterances (see e.g. Pearson, 2015a).

[3]In (2), the deserving predicate itself is embedded under an attitude predicate, which is immaterial to the topic.

(2)

unum	*hoc*	*scio,*	*[hanc$_i$*	*meritam*	*esse*	*[ut*	*memor*
only.ACC	this.ACC	know.1SG	she.ACC	deserve.PTCP	be.INF	that	mindful.NOM

esses	*sui$_i$]]*
be.SBJV.2SG	REFL.GEN

'I know only this, that she$_i$ has deserved that you remember her$_i$.' (Ter. Andr. 281; Kühner and Stegman, 1955: p. 613)

This is not a Latin quirk. LDRs are also found in non-attitudinal environments in Tamil and Japanese, while they are restricted to indirect discourse in Mandarin and Icelandic. Cross-linguistic work suggest that long-distance reflexivity in non-attitudinal environments is related to perspective shift (Kuno and Kaburaki, 1977; Sells, 1987; Sundaresan, 2012, a.o.).

The non-attitudinal cases are challenging to the analysis of LDRs: Given the AH-orientation of LDRs in indirect discourse, an account involving centred worlds easily comes to mind. However, it is difficult to see how a centred worlds analysis could be extended in a motivated way to the non-attitudinal cases. An alternative is to propose a unified account of perspective shift both inside and outside of indirect discourse, and link LDR reference to this perspectival mechanism. The challenge then is to correctly predict AH-orientation in indirect discourse.

This paper will argue for such a unified approach to perspective shift, based on event semantics. In indirect discourse, the perspective is shifted to the agent of an utterance event or the experiencer of a mental state, which accounts for the AH-orientation. In non-attitudinal environments, other roles are involved. Furthermore, LDRs are argued to be discourse anaphors with presuppositional restrictions to perspective holders.

My analyses will be framed in Partial Compositional DRT (PCDRT; Haug, 2013). The primary motivation for analyzing long-distance reflexivity in a dynamic semantic framework is the occurrence of LDRs in so-called *unembedded indirect discourse* (Bary and Maier, 2014), stretches of indirect discourse which are not syntactically embedded and which often span multiple sentences. (3) is a Latin example of this. The phenomenon is also attested in Icelandic (Sigurðsson, 1990: sect. 3.3), and similar phenomena are found e.g. in Tamil and Japanese (Sundaresan, 2012: sect. 3.1.2; Sells, 1987: p. 455).

(3)

pro$_i$	*misit*	*enim*	*puerum$_j$:*	*se$_i$*	*ad*	*me*	*venire.*
	sent	for	boy.ACC	REFL.ACC	to	me	come.INF

'[Hortensius$_i$] sends a boy$_j$: [to say that] he$_i$ will come to me.' (Cic. Att. 10.16.5; Jøhndal 2012: p. 132)

An analysis of LDRs in unembedded indirect discourse is given in my doctoral dissertation[4], but will be left out here. The dissertation will also include a more extensive version of the present account, including assumptions about compositionality.

[4]to be submitted at the University of Oslo in March 2017.

This paper is organized as follows: In section 2 I discuss some previous accounts of LDRs and point out a number of challenges. Section 3 shows how LDRs in indirect discourse can be accounted for by means of an event-based approach to perspective shift and an anaphoric semantics of LDRs. The account is extended to a non-attitudinal case of long-distance reflexivity in section 4. Finally, section 5 concludes the paper and suggests some topics for future research.

2. Previous accounts

Some version of a centred worlds or context quantification semantics is usually appealed to in contemporary analyses of AH-referring pronominals such as PRO, shifted indexicals and logophors (see e.g. Chierchia, 1989; Schlenker, 2003; Pearson, 2015b). This has also been tried out for LDRs: In their analysis of LDRs in Mandarin indirect discourse, Huang and Liu (2001) argue that the reflexive undergoes LF movement to the left periphery of the clause containing it. The moved pronoun is interpreted as an individual abstractor, turning the reported proposition into a property. This property is in turn interpreted as a de se attitude of the AH, following Lewis (1979) and Chierchia (1989). A slightly different, but related semantics is used in Oshima (2007). He draws on Schlenker (2003)'s context shift analysis of logophors to account for LDRs in indirect discourse in Japanese: They are indirect indexicals referring to the agent of a reported speech/thought context. Analyses of this kind readily account for the AH-orientation of LDRs, as the assumed semantics of indirect discourse makes available a variable with the right denotation: the centre or the reported contextual agent. However, it is unclear how analyses along such lines can be extended to non-attitudinal cases of long-distance binding, as they rely on specific semantic properties of indirect discourse to model long-distance binding.

Oshima proposes a separate analysis for the non-attitudinal cases in terms of perspective or empathy, following Kuno (1987). Perspectival expressions such as *to the left of*, *his/her dear* need to be evaluated relative to a perspective holder. By default, the perspective holder is the speaker, but in certain environments, the perspective can be shifted to a discourse-internal participant (see Bylinina et al., 2014 for an overview of the phenomenon and the relevant literature). LDRs in non-attitudinal environments have been shown to refer to shifted perspective holders (Kuno and Kaburaki, 1977; Kuno, 1987; Sells, 1987; Sundaresan, 2012; Bylinina et al., 2014; Charnavel, 2016).[5] There seems to be strong empirical reasons for analyzing the non-attitudinal cases in terms of perspective. However, it seems somewhat unsatisfactory to analyze attitudinal and non-attitudinal, perspectival LDRs along entirely different lines. Preferably, an account of long-distance reflexivity should explain why the reflexive has specifically these two uses in several languages.

A possible way to go is to assume that all LDRs are perspective sensitive, and propose an account of perspective shift which applies both in indirect discourse and in non-attitudinal environments. A prominent example of an approach along such lines is Sells (1987). Sells analyzes

[5] In languages where reflexive pronouns can take 1/2p antecedents, reference to the default perspective holder may be possible too. This seems to be the case in Mandarin, cf. Huang and Liu (2001: sect. 3.2.1), and at least in some dialects of Japanese, cf. Nishigauchi (2014: p. 159).

perspective in terms of three primitive discourse roles: the *Source*, i.e. a communicative agent, the *Self*, the individual whose mental content a piece of discourse represents, and the *Pivot*, the individual from whose spatio-temporal location the proposition is evaluated. By default, all three roles are assigned to the external speaker, but in given contexts, one or more of the roles can be shifted to a discourse-internal participant. Furthermore, he assumes that the shifting of the roles obeys an implicational hierarchy: If the Source is shifted, so are the Self and the Pivot, and shifting the Self implies a shift of the Pivot. However, the Pivot can be internal while the two other roles are external. In complements to utterance predicates, the Source, together with the two other roles, is shifted to the utterance agent. In complements to mental state predicates, the Self and the Pivot are shifted, while the Source remains external. In non-attitudinal cases of perspective shift, only the Pivot is shifted. LDRs are taken to be discourse anaphors restricted to shifted roles. To account for cross-linguistic distributional differences, Sells assumes that languages differ with respect to which role the LDR picks up.

By subdividing perspective into three discourse roles, Sells manages to capture attitudinal and non-attitudinal perspective shift in a uniform way. There are, however, problematic sides to the analysis. Firstly, it does not build on commonly assumed semantic machinery, but postulates dedicated discourse roles. Secondly, Sells uses uninterpreted DRT representations, and it is therefore not possible to calculate truth conditions or see how the discourse roles integrate with attitudinal semantics more generally.

Sundaresan (2012) offers a generalized perspective account of LDRs in Tamil, although in a quite different framework from Sells'.[6] In Tamil, LDRs are found in indirect discourse, where they refer to the AH, and in clauses characterized by spatio-temporal perspective shift. Sundaresan analyzes LDR binding as a two-step process: Firstly, there is a covert pronoun in the specifier of a perspectival functional projection of the clause containing the LDR. This perspective pronoun binds the LDR syntactically. Secondly, the perspective pronoun itself is resolved to a suitable antecedent. The covert perspective pronoun is not structurally bound, but finds its antecedent through some semantic/pragmatic mechanism. The antecedent of the covert perspective pronoun must be suitable, i.e. it must be an appropriate perspective holder and have phi-features matching those of the perspective pronoun. In other words, the LDR is always locally bound by the perspective pronoun, and the long-distance effect is due to the kind of antecedents the perspective pronoun can take. The perspective pronoun also has a semantic function in the clause that contains it. Clauses of indirect discourse are interpreted relative to the referent of the covert pronoun. It is, in other words, the perspective pronoun, not the attitude predicate, which is responsible for the AH-relative interpretation of the indirect discourse. In non-attitudinal perspective-shifting environments, the perspective pronoun shifts the spatial or temporal interpretation of the clause to its referent (see in particular Sundaresan, 2012: sect. 4.3).

Sundaresan's analysis does not spell out formally the semantic/pragmatic mechanism which resolves the perspective pronoun to an antecedent. Regardless of how this is done, the analysis makes a clearly unwanted semantic prediction in a specific environment: When an LDR is

[6] Analyses along similar lines have been proposed for Japanese by Nishigauchi (2014) and for French by Charnavel (2016).

embedded under multiple report predicates with different subjects, it is ambiguous between a resolution to a higher and a lower antecedent in Tamil as well as in other languages with LDRs (see e.g. Sundaresan, 2012: pp. 15-17; Solberg, 2011: pp. 27-28; Huang and Liu, 2001: pp. 146-147). The following fake English example illustrates this point, where the LDR can take both the sentence's AHs, John or Peter, as an antecedent.[7] Julie, the addressee of John's utterance, is not a suitable antecedent, as she is not an AH.

(4) John$_i$ says to Julie$_j$ that Peter$_k$ believes that Mary loves $SE_{i/k/*j}$.

On Sundaresan's approach, an LDR is always syntactically bound by its clause-local perspectival pronoun. Ambiguities like in (4) can therefore not be due to the binding of the LDR itself. According to Sundaresan, this pattern is a result of an ambiguity on the covert perspective pronoun (Sundaresan, 2012: sect. 5.5). Remember, however, that the perspective pronoun is also responsible for the interpretation of the clause containing it. On the reading of (4) where the LDR is bound by John, the higher AH, we are therefore forced to conclude that the report of Peter's belief is relativized to John, not Peter, which is clearly wrong.

To sum up: A generalized account of perspective seems like a promising way to unify the attitudinal and non-attitudinal cases of long-distance reflexive binding. It is important, however, that the account predicts AH-reference in indirect discourse and is able to handle the ambiguity of LDRs embedded under multiple attitude predicates.

3. A new account of perspectival reflexives in indirect discourse

The alternative I am proposing has two components: Firstly, I argue for a generalized account of perspective shift based on events and thematic roles, in part inspired by the account of context shift in Deal (2014). In indirect discourse, the perspective is shifted to the utterance agent or the experiencer of a mental state, which explains the AH orientation; in non-attitudinal environments, other roles are used. Secondly, LDRs are claimed to be discourse anaphors with presuppositional restrictions to perspective holders. When there are multiple perspective holders accessible to the anaphoric pronoun, as when it is embedded under multiple attitude predicates, ambiguity is immediately predicted. Section 3.1 presents an event semantics of indirect discourse and the implementation of perspective shift. Perspective anaphors are introduced in section 3.2. In section 4, I show how a non-attitudinal case of long-distance binding can be accounted for.

3.1. Perspective shift in indirect discourse

In standard semantic treatments of indirect discourse, an attitude verb is taken to quantify over the worlds compatible with the AH's speech, thought, desire etc. (Hintikka, 1969). In other words, the complement proposition is relativized to an individual. Events are usually omitted entirely.

[7] *SE* represents an LDR here.

Valentine Hacquard has put forward an event-based semantics for indirect discourse (Hacquard, 2006, 2010; Anand and Hacquard, 2008). Utterance and mental state verbs involve a special kind of event, a *contentful event*, that is, an event associated with a propositional content. Instead of relativizing the complement proposition to the AH, it must hold in the worlds compatible with the content of the contentful event. (5) is a simple example of a speech report and the corresponding PCDRT representation, based on Hacquard's semantics:[8]

(5) a. John says that it is hailing.

b.
$$\begin{array}{|l|}\hline e_1 x_1 \\ \hline john(x_1) \\ ag(e_1) = x_1 \\ assertion'(e_1) \\ content(e_1, \begin{array}{|l|}\hline e_2 \\ \hline hailing'(e_2) \\ \hline \end{array}) \\ \hline \end{array}$$

The superordinate event e_1 is an assertion event with John as the agent. The interpretation of the complement is relativized to this event. In my PCDRT semantics, the object embedded under the contentful event is a DRS, which is important for the anaphora account to be introduced below.

Attitudinal events have another property which is crucial for my purpose: They are associated with what we might call a *conscious participant*, an individual whose words or mind the complement clause expresses. This individual can be characterized in terms of thematic roles: It is the agent in the case of utterance events, or the experiencer in the case of mental states. Note that this individual corresponds to the AH in more traditional attitudinal semantics. It is therefore possible to use the thematic roles of the attitudinal event to uniquely identify the AH, and this will be a crucial component in the account of perspective shift.

The idea of using the Hacquardian event semantics of indirect discourse to analyze shifting phenomena comes from Deal (2014)'s account of context shift in Nez Perce. In that language, a number of indexicals can be shifted under attitude verbs. In particular, first person pronouns can be shifted to the the AH. According to Deal, this is the consequence of operators in the left periphery of the attitudinal complement clause which overwrite coordinates of the context parameters with values derived from the thematic roles of the attitudinal event. In particular, the speaker coordinate can be overwritten by the agent/experiencer of the attitudinal event, which gives the shifted first person reading within the indirect discourse.

[8] The representation in (5b) looks a bit different from the representations in e.g. Hacquard (2010), but it does in fact involve the same modal semantics. In PCDRT, DRSs abbreviate complex lambda terms (Haug, 2013). In examples like (5b), the *content* condition abbreviates a quantification over worlds compatible with the content of the superordinate event. This will be spelled out in detail in my dissertation.

In my analysis, thematic roles are used in a similar way to model perspective shift to the AH in indirect discourse. Since I have an anaphoric account of long-distance binding, perspective shift should interact with anaphora resolution. One way of modelling that interaction is to introduce a dedicated discourse referent for the perspective holder within the embedded DRS. When perspective shift is added to the DRS in (5b), the result is as follows:

(6)
$$\begin{array}{|l|}\hline e_1 x_1 \\ \hline john(x_1) \\ ag(e_1) = x_1 \\ assertion'(e_1) \\ content(e_1, \begin{array}{|l|}\hline e_2 x_2 \\ \hline PHolder_{reg}(x_2) \\ \partial(x_2 = \iota x.cp(e_1) = x) \\ hailing'(e_2) \\ \hline \end{array}) \\ \hline \end{array} = \begin{array}{|l|}\hline e_1 x_1 \\ \hline john(x_1) \\ ag(e_1) = x_1 \\ assertion'(e_1) \\ content(e_1, \begin{array}{|l|}\hline e_2 x_2 \\ \hline PHolder_{reg}(x_2) \\ \partial(x_2 = x_1) \\ hailing'(e_2) \\ \hline \end{array}) \\ \hline \end{array}$$

A discourse referent x_2 is introduced in the embedded DRS. This discourse referent is associated with a special condition, $PHolder_{reg}$, marking it as a perspective holder. The subscript *reg* on this condition indicates that it is a *register condition*, a purely formal condition which labels the discourse referent without predicating anything of the individual assigned to that discourse referent.[9] This is important, because being a perspective holder is presumably not itself part of truth-conditional semantics. It only affects truth-conditional semantics when perspective-sensitive expressions are present. Furthermore, x_2 is associated with a condition which states that the individual assigned to x_2 is equal to the cp (conscious participant) of the embedding event, i.e. its agent or experiencer. This equality condition is marked as presuppositional by the partial operator ∂ (Beaver, 1992). We know from the superordinate DRS that the experiencer of e_1 is x_1. We can therefore replace the iota-expression with x_1 in the equality condition, as I have done in the second DRS in (6).

Outside of shifting environments, the external speaker is the perspective holder. In a complete account, there should therefore be a perspective holder discourse referent in the matrix DRS. I leave that out here, however. LDRs referring to contextual participants is ruled out in Latin, since reflexive pronouns are obligatorily third person (but see footnote 5).

3.2. LDRs as perspective anaphors

In (6), the perspective shifting machinery serves no purpose, as there are no perspective-sensitive expressions in the indirect discourse. Let us now consider a sentence with an LDR,

[9] This is possible because PCDRT has a type distinction between discourse referents, which are *registers*, and the individuals (or events, time intervals etc.) assigned to those registers (cf. Haug, 2013). Register conditions apply to registers, while normal conditions apply to entities assigned to registers.

where the shifting does have an effect. In the Latin example in (7), an LDR is bound by the experiencer of a mental state predicate.[10]

(7) *Iam* *inde* *ab* *initio* *Faustulo*$_i$ *spes* *fuerat* *[regiam* *stirpem*
already since from beginning Faustulus.DAT hope.NOM was royal.ACC lineage.ACC
apud *se*$_i$ *educari].*
before REFL.ACC educate.INF.PASS

'Already from the beginning, Faustulus$_i$ had the hope that someone of royal lineage was being educated with him$_i$.' (Liv. 1.5.5; Benedicto, 1991: ex. (21))

Note that in the Latin text, the mental state predicate is a nominative noun, and the experiencer is a dative, a pattern that isn't rendered in the translation.

The LDR has the following denotation:

(8) $$[[se]]^{M,g} = \lambda P. \begin{array}{|l|}\hline \bar{x}_1 \\ \hline \partial(PHolder_{reg}(\mathscr{A}(x_1))) \\ \hline \end{array} ;P(x_1)$$

It introduces a discourse referent x_1. The overline over the discourse referent marks it as discourse anaphoric. In PCDRT, anaphors are discourse referents with an underspecified resolution to an antecedent. The actual resolution is handled by a function $\mathscr{A}$ which is driven by pragmatic inference, but constrained by the accessibility relations of DRSs (Haug, 2013: sect. 5.4). The discourse referent is furthermore associated with a presuppositional condition that the antecedent discourse referent, $\mathscr{A}(x_1)$, is a perspective holder, i.e. it is associated with $PHolder_{reg}$.[11]

With this denotation for the LDR, we can draw up a DRS structure of a somewhat simplified version of (7):

[10] In (7) the complement clause is an *accusative-with-infinitive* construction, not a finite clause. There are good empirical reasons for treating the binding into this clause type on par with binding into Latin finite clauses, e.g. because of the lack of subject orientation and the possibility of discourse antecedents in unembedded indirect discourse, as in example (3) (see e.g. Solberg, 2011).

[11] $PHolder_{reg}$ applies to $\mathscr{A}(x_1)$, not simply x_1, as $PHolder_{reg}$ takes discourse referents, not individuals, as arguments. Discourse referents and individuals are of different types (cf. footnote 9), and while the discourse referent of the LDR and of the antecedent will be assigned to the same individual, they are still distinct discourse referents.

(9)
$$\begin{array}{|l|}\hline e_1 x_1 \\ \hline faustulus(x_1) \\ exp(e_1) = x_1 \\ hope'(e_1) \\ content(e_1, \begin{array}{|l|}\hline e_2 x_2 \bar{x}_3 \\ \hline PHolder_{reg}(x_2) \\ \partial(x_2 = x_1) \\ \partial(PHolder_{reg}(\mathscr{A}(x_3))) \\ exp(e_2) = x_3 \\ having\_royal\_study\_buddy'(e_2) \\ \hline \end{array}) \\ \hline \end{array}$$
$$\mathscr{A} = \{\langle x_3, x_2 \rangle\}$$

A perspective holder discourse referent x_2 is introduced in the complement. x_3 is the anaphoric discourse referent of the LDR. It must be resolved to a perspective holder antecedent. In this example, there is only one, namely x_2, and $\mathscr{A}$ therefore maps x_3 to x_2. The individual assigned to x_2 is equal to x_1, Faustulus, as he is the experiencer of the hoping state e_1. The LDR ends up referring to Faustulus.

On this approach, the AH orientation of LDRs is the consequence of perspective shift to the agent/experiencer of the attitudinal event in indirect discourse. It is not modelled in a fine-grained modal semantics of indirect discourse, as it would be on a centred worlds approach. LDRs will typically refer back to subjects, as agents/experiencers are frequently linked to subjects. Whenever syntax links the agent/experiencer to non-subject arguments, as in (1) and (7), non-subject-orientation is correctly predicted.

The scope of the perspective shifting is a consequence of anaphoric accessibility: The perspective holder discourse referent is assigned in the embedded DRS representing the indirect discourse, and is therefore accessible within that DRS and in DRSs embedded under it (Kamp et al., 2011: pp. 134-137; Haug, 2013: sect. 5.2).

In (9) there was only one potential antecedent for the LDR. (10) is the DRS of (4), where an LDR is embedded under two attitude verbs with different subjects:

(10)
$$
\begin{array}{|l|}\hline
e_1x_1x_2x_3x_4\\ \hline
john(x_1)\\
julie(x_2)\\
peter(x_3)\\
mary(x_4)\\
ag(e_1)=x_1\\
goal(e_1)=x_2\\
assertion'(e_1)\\
content(e_1, \begin{array}{|l|}\hline
e_2x_5\\ \hline
PHolder_{reg}(x_5)\\
\partial(x_5=x_1)\\
exp(e_2)=x_3\\
belief'(e_2)\\
content(e_2, \begin{array}{|l|}\hline
e_3x_6\bar{x}_7\\ \hline
PHolder_{reg}(x_6)\\
\partial(x_6=x_3)\\
\partial(PHolder_{reg}(\mathscr{A}(x_7)))\\
exp(e_3)=x_4\\
th(e_3)=x_7\\
loving'(e_3)\\ \hline
\end{array})\\ \hline
\end{array})\\ \hline
\end{array}
$$
$\mathscr{A} = \{\langle x_7, x_6\rangle\}$ or $\mathscr{A} = \{\langle x_7, x_5\rangle\}$

The anaphoric discourse referent x_7 has two accessible perspective holders: the local perspective holder x_6, or x_5, the perspective holder of the higher complement. There are other discourse referents in x_7's accessibility path too, but none of them are compatible with its perspectival presupposition, and are consequently not suitable. There are therefore two alternative $\mathscr{A}$-functions compatible with this DRS, one which maps x_7 to x_6 and one which maps x_7 to x_5.

A crucial difference between this approach and that of Sundaresan (2012), discussed above, is that the LDR does not need to be locally bound in any way. Therefore, the ambiguity of deeply embedded LDRs can be accounted for as a consequence of recursive perspective shift, without making problematic predictions for the modal semantics. There is also no need to posit any kind of covert structural ambiguity, as the LDR does not retrieve its antecedent through structural binding.

4. How to extend the account to LDRs outside of indirect discourse

There is nothing inherent to this system of perspective shift and long-distance reflexivity which restricts it to agents and experiencers. It is, for example, possible to model addressee-oriented

LDRs in indirect discourse, which is attested in complements to interrogative verbs in Japanese (Bylinina et al., 2014: sect. 2.4). But perhaps more importantly, nothing restricts perspective shift to attitudinal events, and we can therefore extend the account to non-attitudinal environments.

It seems to me to be more difficult to make strong empirical generalizations for long-distance reflexivity outside of indirect discourse than inside. A complete account should rely on a detailed investigation of the phenomenon in a language where such LDRs are widely attested. In this paper, I will simply draw up a draft of what such an account might look like, using a Latin example.

In Latin, LDRs are occasionally attested in subjunctive complement clauses to verbs meaning *deserve*, as exemplified in (11) (= (2)). The LDR picks up the subject of *deserve*:

(11)

unum	*hoc*	*scio,*	*[hanc$_i$*	*meritam*	*esse*	*[ut*	*memor*
only.ACC	this.ACC	know.1SG	sheACC	deserve.PTCP	be.INF	that	mindful.NOM

esses	*sui$_i$]]*
be.SBJV.2SG	REFL.GEN

'I know only this, that she$_i$ has deserved that you remember her$_i$.' (Ter. Andr. 281; Kühner and Stegman, 1955: p. 613)

Deserve does not have an attitudinal semantics, as it does not imply that the subject is aware of the complement proposition. The difference between predicates like *deserve* and attitude predicate is minimal, however, as both have a modal semantics. I therefore assume that a deserving state is contentful. Furthermore, I analyze the subject as a benefactive. The perspective is shifted to the benefactive, as the following DRS illustrates:

(12)

$$\begin{array}{|l|}\hline e_1 x_1 \\ \hline ben(e_1) = x_1 \\ deserving'(e_1) \\ content(e_1, \begin{array}{|l|}\hline e_2 x_2 x_3 \bar{x}_4 \\ \hline PHolder_{reg}(x_2) \\ \partial(x_2 = \iota x.ben(e_1) = x)) = \partial(x_2 = x_1) \\ \partial(PHolder_{reg}(\mathscr{A}(x_4))) \\ exp(e_2) = x_3 \\ th(e_2) = x_4 \\ remembering(e_2) \\ \\ \hline \end{array}) \\ \\ \hline \end{array}$$

$\mathscr{A} = \{\langle x_4, x_2 \rangle\}$

The only difference between the embedded DRS in (12) and the embedded DRSs in the attitudinal cases is the thematic role of the individual assigned to the perspective holder discourse referent. In indirect discourse, it is the agent/experiencer of the attitudinal event; in (12) it is a benefactive argument. There is no need for a lexical ambiguous pronoun: We can use the same denotation for attitudinal and non-attitudinal LDRs.

5. Conclusion and remaining issues

In this paper, I have identified some problematic aspects of existing analyses of LDRs. Centred worlds analyses account well for the AH orientation of LDRs in indirect discourse. It is difficult to generalize such accounts to LDRs in non-attitudinal environments, however. Instead, I am favourable to accounts where long-distance reflexivity, both inside and outside of indirect discourse, is sensitive to perspective shift.

A challenge with such generalized perspective accounts, however, is to make sense of the AH orientation in indirect discourse. I have argued that this can be done if perspective shift is modelled using events and thematic roles. In indirect discourse, the perspective is shifted to the agent/experiencer of the attitudinal event, while other roles may be used in other environments.

Furthermore, I have argued that LDRs are discourse anaphors with presuppositional restrictions to perspective holders. By using anaphora, the ambiguity of LDRs embedded under multiple attitude predicates is immediately predicted.

An issue which has not been addressed here is the relationship between local and long-distance reflexives. There are good empirical reasons for distinct treatments of the two uses, both in Latin and other languages (cf. my doctoral dissertation; Huang and Liu, 2001; Reuland, 2001). However, there must be some reason why the same lexical item has these two different uses in language after language.

Another interesting issue is the cross-linguistic differences in the distribution of LDRs. As mentioned in the introduction, LDRs are restricted to indirect discourse in some languages, while they have a wider distribution in others. This might be related to differences in perspective shift, or alternatively, in the semantics of the reflexive itself.

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Proportional comparatives and relative scales[1]

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Abstract. This paper examines the proportional interpretation of comparatives such as *More residents of Ithaca than New York City know their neighbors*, taking these as the starting point for an investigation of relative or proportional measurement more generally. Two mechanisms for deriving mappings from individuals to degrees of proportion are considered, the first based on posited proportional entries for *many/few*, the second involving proportional measure functions. It is shown that only the measure function approach adequately accounts for the distribution of proportional expressions and proportional interpretations. A further consequence is to eliminate the need to analyze words such as *many* as lexically ambiguous.

Keywords: degree, measurement, comparative, proportion, partitive.

1. Introduction

The sentences in (1)-(2) exemplify a curious type of comparative construction that to my knowledge was first discussed by Partee (1989):

(1) More residents of Ithaca than New York City know their neighbors.
(2) More Norwegians than Brazilians have university degrees.

At first glance, examples of this sort are entirely unobjectionable, but on further reflection, one realizes there is something rather odd about them. The number of residents of Ithaca, NY (population 30,000) who know their neighbors is without doubt smaller than the number of inhabitants of New York City (population 8 million) who do; and likewise, in absolute terms there are certainly a smaller number of Norwegians than Brazilians with university degrees. Nevertheless, both of these sentences have salient interpretations on which they are true.

Intuitively, on their true readings the above examples express comparisons of proportions: it is the <u>proportion</u> of Ithaca residents who know their neighbors that is greater than the corresponding <u>proportion</u> of New York City residents (and similarly, *mutatis mutandis*, for proportions of Norwegians versus Brazilians with degrees). The goal of this paper is to develop a compositional semantic analysis of examples such as (1)-(2) on their proportional readings, and in doing so to investigate the semantic structures underlying the interpretation of proportional expressions more generally.

In a degree-based semantic framework, comparatives are analyzed as expressing relations between degrees on a scale corresponding to some dimension of measurement (Cresswell 1977; von Stechow 1984; Heim 1985; Kennedy 1997; see Beck 2011 for a recent review). Taking this approach, we might loosely represent the meaning of (1) as follows:

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(3) $max\{d : d$-many Ithaca residents know their neighbors$\} \succ$
$max\{d : d$-many NYC residents know their neighbors$\}$

If we take the degrees d here to range over values on the scale of cardinality – that is, natural numbers – we get only the false absolute reading. To get the true proportional reading, it is necessary for d to range over degrees of proportion. That is, we require a scale that tracks proportions of a totality. In the context of current work in degree semantics, this is an unusual idea. As has been observed by Cresswell (1977), Wellwood (2015) and many authors in between, comparative *more* can operate over a variety of dimensions, including not just cardinality (e.g. (4a)) but also mass quantity dimensions such as volume (e.g. (4b)) as well as adjectival dimensions such as intelligence (e.g. (4c)).

(4) a. Sue owns more books than John. (cardinality)
b. Sue drank more wine than John. (volume)
c. Sue is more intelligent than John. (intelligence)

The existence of proportional scales, however, is not generally recognized. I will argue here that precisely such scales are a necessary part of the degree ontology, and that they play a role beyond comparative constructions of the sort exemplified above.

The structure of the paper is as follows: Section 2 introduces two possible approaches to the semantics of proportional comparatives, the first based on a well known ambiguity in the interpretation of the vague quantity expressions *many* and *few*, the second making use of the notion of domain-restricted measure functions, one instantiation of which is a proportional measure function. Section 3 turns to other sorts of proportional expressions, comparing how the two proposed solutions to proportional comparatives fare in accounting for their distribution. Section 4 returns to consider the readings available to *many* and *few*, and demonstrates that only the measurement-based approach allows a principled explanation for the constraints on the availability of proportional readings of their positive and comparative forms. Finally, Section 5 wraps up with some conclusions and questions still left open.

2. Two accounts of proportional comparatives

2.1. Ambiguous *many* and *few*

Since Bresnan (1973) it has been common to analyze *more* and *fewer* as the comparative forms of *many/much* and *few*, respectively. As discussed by Milsark (1977) and especially Partee (1989), *many* and *few* themselves appear to be ambiguous between two distinct readings which have come to be called ‘cardinal’ and ‘proportional’. For instance, (5) might be interpreted to mean simply that a large (small) number of aspens burned (the cardinal reading) or instead that a large (small) proportion of some contextually relevant set of aspens burned (the proportional reading).

(5) Many (few) aspens burned.

The cardinal/proportional ambiguity is easiest to detect in the case of *few*. On its proportional interpretation, *few* can be paraphrased as 'a small proportion of'. But on the cardinal reading, *few Ns* can actually be all of the relevant *Ns*, as demonstrated by the following example (from Partee 1989):

(6) Few egg-laying mammals were found in our survey, perhaps because there are few.

Partee argues that the existence of these two readings is more than a matter of radical context dependence but instead involves a true lexical ambiguity, which corresponds to a more basic distinction in semantic type; specifically, she proposes to analyze *many/few* as ambiguous between an adjectival entry with cardinal semantics and a quantificational entry with proportional semantics.

Partee's notion of a lexical ambiguity has been adopted by many later authors (e.g. Herburger 1997; Cohen 2001; though see Greer 2014 for an opposing view). Recently, Romero (2015) has developed an updated version of the ambiguity account in a degree-based framework, according to which *many/few* are ambiguous between cardinal and proportional entries, each of which has the type of a gradable quantifying determiner, type $\langle d, \langle et, \langle et, t \rangle \rangle \rangle$:[2]

(7) a. $[\![many_{CARD}]\!] = \lambda d \lambda P_{\langle et \rangle} \lambda Q_{\langle et \rangle}.|P \cap Q| \succeq d$

b. $[\![many_{PROP}]\!] = \lambda d \lambda P_{\langle et \rangle} \lambda Q_{\langle et \rangle}.\dfrac{|P \cap Q|}{|P|} \succeq d$

(8) a. $[\![few_{CARD}]\!] = \lambda d \lambda P_{\langle et \rangle} \lambda Q_{\langle et \rangle}.|P \cap Q| \prec d$

b. $[\![few_{PROP}]\!] = \lambda d \lambda P_{\langle et \rangle} \lambda Q_{\langle et \rangle}.\dfrac{|P \cap Q|}{|P|} \prec d$

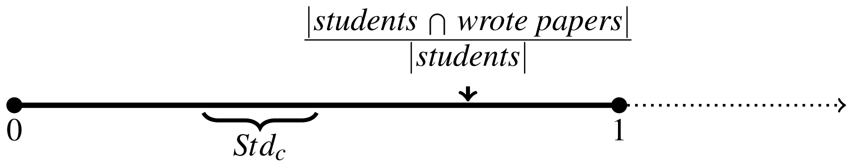
In both cases, the initial type *d* argument can be saturated or bound by a degree modifier, just as in the case of gradable adjectives such as *tall*. When *many/few* appear in their unmodified form (e.g. as in (5)), it is proposed that this role is played by a null degree operator *POS*, again in parallel to a standard analysis of the unmodified forms of gradable adjectives. For example, if *POS* is taken to introduce a standard of comparison in the form of a 'neutral range' Std_c relative to some context *c* (von Stechow, 2009), a simple example such as (10a) on its proportional reading receives the interpretation in (10b), depicted in (10c):

(9) $[\![POS]\!]^c = \lambda I_{\langle dt \rangle}.Std_c \subset I$

(10) a. Many students wrote papers.
POS$_1$ [[t_1-many$_{PROP}$ students] wrote papers]

b. $Std_c \subset \{d : \dfrac{|students \cap wrote\ papers|}{|students|} \succeq d\}$

[2]Romero further notes that *few* might be decomposed into a degree-negation operator plus *many*. Note also that while she does not discuss quantificational *much* and *little*, these might be handled by replacing the cardinality operator with a measure function suitable for portions of matter.

c. 

Returning to the topic of the present paper, the proportional entry for *many* in (7b) in combination with standard assumptions about the syntax and semantics of comparatives give us what we need to derive the proportional reading of our original examples. Specifically, we can take the comparative morpheme *-er* to express a relation between two sets of degrees:

(11) $[\![\text{-}er]\!] = \lambda I_{\langle dt \rangle} \lambda J_{\langle dt \rangle}.max(J) \succ max(I)$

Syntactically, an example such as (12) is taken to be a (covert) clausal comparative, with the *than*-clause containing an elided copy of *many* whose degree argument is bound by a null operator *OP*. The comparative morpheme *-er* plus the *than* clause as a whole originate within the noun phrase, but must undergo quantifier raising (QR) for type-driven purposes, yielding the LF in (13).

(12) More Ithaca residents than New York City residents know their neighbors.

(13) [-er than [OP$_2$ [t_2 ~~many~~ NYC residents ~~know their neighbors~~]]]$_1$ [t_1 many Ithaca residents know their neighbors]

The first argument of *-er* is saturated by the *than* clause, while the second is provided by the matrix clause via lambda abstraction over the trace of the raised comparative morpheme, yielding the following interpretation:

(14) $$max\{d : [\![d\text{-}many_{PROP}]\!]([\![Ithaca\ residents]\!])([\![know\ neighbors]\!])\} \succ$$
$$max\{d : [\![d\text{-}many_{PROP}]\!]([\![New\ York\ City\ residents]\!])([\![know\ neighbors]\!])\}$$

$$= max\{d : \frac{|Ithaca\ residents \cap know\ neighbors|}{|Ithaca\ residents|} \succeq d\} \succ$$
$$max\{d : \frac{|NYC\ residents \cap know\ neighbors|}{|NYC\ residents|} \succeq d\}$$

As desired, this expresses a comparison of the proportions of residents of the two cities who know their neighbors. That is, we are able to derive the proportional reading of our original example (1).

2.2. Domain-restricted measure functions

The account developed in the previous section relies crucially on the analysis of *many/few* themselves as parameterized quantificational determiners, the same semantic type (once their initial type *d* argument is saturated) as quantifiers such as *every*. While this is a common view, which can be traced back to classic works such as Barwise and Cooper (1981), there is evidence that it cannot be correct. The issue is that words of the *many* class have uses on which they do not quantify over individuals, a prime example being the differential use (e.g. *Many fewer / few more than 100 students attended the lecture*). Instead, authors including Rett (2006, 2008) and Solt (2009, 2015) propose that *many/few* have degree-based interpretations.

To formalize this, we make the following assumptions about the semantics of degree and measurement. A **scale** is a triple of the following form:

(15) $S = \langle D, \succ, DIM \rangle$, where
•D is a set of degrees;
•$\succ$ is an ordering relation on that set;
•DIM is a dimension of measurement.

This formalization has the effect of establishing a one-to-many relation between dimensions of measurement and the scales that track them (as a simple example, think of height measured in inches vs. centimeters). Entities are mapped to degrees by **measure functions**, where μ_{DIM} is a function that maps members of the domain of individuals D_e to degrees on some scale corresponding to dimension DIM.

Following Solt (2015), vague quantity words such as *many* can then be interpreted as gradable quantifiers over degrees (where *many/few* are distinguished from *much/little* in that the former select for degrees of cardinality, while the latter are blocked in the cardinality case):

(16) a. $[\![\textit{many/much}]\!] = \lambda d \lambda I_{\langle dt \rangle}.d \in I$ (Solt, 2015)
b. $[\![\textit{few/little}]\!] = \lambda d \lambda I_{\langle dt \rangle}.\neg d \in I$

On their (apparently) quantificational uses, the degrees over which these expressions operate are introduced by a phonologically null functional head *Meas*, which encodes an underspecified measure function μ^c_{DIM}:

(17) $[\![Meas]\!]^c = \lambda P_{\langle et \rangle} \lambda x.[P(x) \wedge \mu^c_{DIM}(x) = d]$

The specific dimension introduced by *Meas* is contextually determined, as is the individual scale that tracks that dimension; but we require that the dimension so introduced be **monotonic** on the part-whole relationship between individuals (Schwarzschild, 2006), as defined below:[3]

(18) **Monotonicity constraint:** $\forall x, y \in D_e,\ x \sqsubset y \Rightarrow \mu^c_{DIM}(x) \prec \mu^c_{DIM}(y)$

Once their first degree argument is saturated by a degree expression or its trace, *many/few* have the type of degree operators, which like other such operators (e.g. *POS* in (9) or *-er* in (11)) must undergo QR to be interpreted. A simple quantificational example thus has the LF in (19a); assuming that quantification over individuals arises via existential closure, the corresponding interpretation is that in (19b).[4]

[3]For discussion on the source of this constraint, see Rett (2014).
[4]See Solt (2015) for details of the compositional derivation.

(19) a. Many students wrote papers.
POS$_2$ [t_2 many]$_1$ [[t_1 *Meas* students] wrote papers]
b. $Std_c \subset \{d : \exists x[students(x) \wedge \mu^c_{DIM}(x) = d \wedge wrote\text{-}papers(x)]\}$

If μ^c_{DIM} is set to be a cardinality function, it is the cardinal reading that most naturally emerges: the number of students who wrote papers exceeds some value or range that serves as the threshold for what counts as 'many' in the context. On this approach to words of the *many* class, it is then tempting to treat the proportional reading of sentences such as this contextually, by specifying the standard range introduced by *POS* in such a way that values that exceed it correspond to a large proportion of the relevant totality (here, the students). But this is not sufficient to derive the proportional reading of comparative constructions, for which we need a scale that directly tracks proportions.

To address this, I propose to introduce a new type of measure function, namely one that is restricted to measuring subparts of some entity:[5]

(20) A **domain-restricted measure function** $\mu^c_{DIM;x} \rightarrow S^c_{DIM}$ is a function that maps parts of some entity $x \in D_e$ to degrees on some scale S tracking dimension DIM.

Since the domain of a function of the form in (20) is restricted, its range is likewise restricted to degrees that are measures of some part of the domain, which might constitute a proper subpart of the full scale S.

I further propose that one particular variety of domain-restricted function that the grammar makes available is one that maps parts of an entity to values that encode the proportion they represent of the totality (with respect to the dimension in question):

(21) A **proportional measure function** is a function of the following form:

$$\text{For } y \sqsubseteq x : \mu^c_{DIM;x}(y) = \mu^c_{DIM\text{-}prop;x}(y) = \frac{\mu^c_{DIM}(y)}{\mu^c_{DIM}(x)}$$

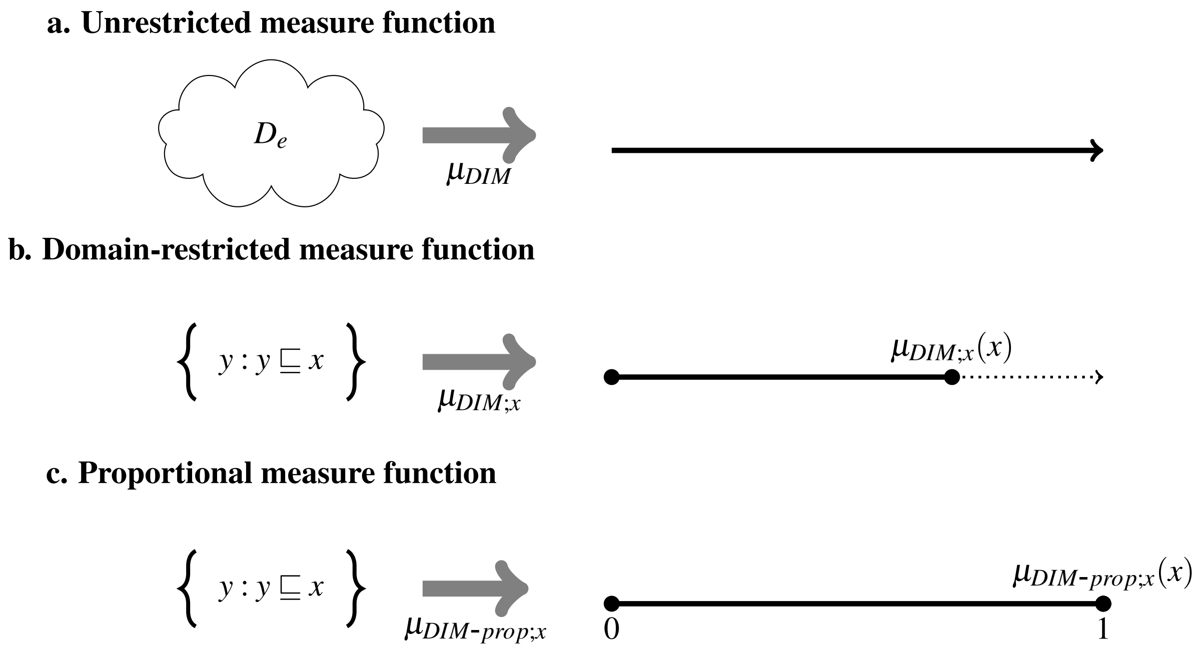
The three types of measure functions discussed here – ordinary unrestricted, domain-restricted and proportional – are depicted graphically in Figure 1.

Importantly, if a measure function μ^c_{DIM} tracking dimension *DIM* satisfies the monotonicity constraint (18), so too do corresponding domain-restricted measure functions $\mu^c_{DIM;x}$, including the proportional measure function $\mu^c_{DIM\text{-}prop;x}$. This means that the latter two sorts are possibilities for the measure function introduced by the functional head *Meas*. Thus I take it that *Meas* can have the following form, where the relevant totality is that formed by summing over entities in the denotation of the common noun phrase:

(22) $[\![Meas]\!]^c = \lambda P_{\langle et \rangle} \lambda x.[P(x) \wedge \mu^c_{DIM;\oplus P}(x) = d]$

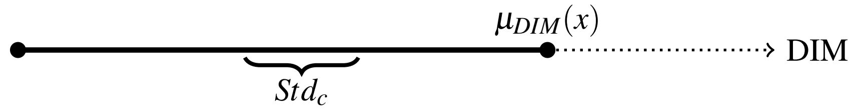
[5]Kennedy (2007) utilizes domain-restricted measure functions of a different sort to account for facts in the adjectival domain. I leave it as an open question whether there might be a connection between the two cases.

Figure 1: Varieties of measure functions



Taking advantage of the possibilities offered by (22), we are able to derive the proportional readings of *many/few* and their comparative forms. Starting with the unmodified case, the proportional reading of examples such as *Many (few) aspens died* can be derived by assuming a domain-restricted measure function, and making one more very plausible assumption, namely that whenever the measure function introduced is of this variety (either an 'ordinary' domain-restricted function or a proportional one), the standard range introduced by *POS* is fully contained within the segment of the scale that is the range of this function, as illustrated below (where *x* is the relevant totality):

(23)



This has the effect of ensuring that *many Ns* is a suitably large proportion of all the *Ns*, and crucially that *few Ns* cannot be all of the *Ns*. While this may seem to be a stipulation, note that essentially the same stipulation is required under the ambiguity analysis (see (10c) above), where it must be assumed that the standard range is fully contained in the interval [0,1].

The proportional interpretation of comparatives can now be derived by taking the contextually determined measure function to be a proportional one $\mu^c_{DIM\text{-}prop;\oplus P}$. Maintaining the earlier assumptions regarding the syntax and semantics of comparative constructions, a relevant example has the LF in (24), and the interpretation in (25), where the underlying dimension that forms the basis for the calculation of proportions is cardinality, indicated by #.

(24) [-er than [OP$_4$ [t_4 ~~many~~$_3$ [t_3 *Meas* NYC residents ~~know their neighbors~~]]]]$_2$ [t_2 many$_1$ [t_1 *Meas* Ithaca residents know their neighbors]]

(25)
$$max\{d : \exists x[Ithaca\text{-}res(x) \wedge \mu^c_{\#\text{-}prop;\oplus Ithaca\text{-}res}(x) = d \wedge know\text{-}neighbors(x)]\} \succ$$
$$max\{d : \exists x[NYC\text{-}res(x) \wedge \mu^c_{\#\text{-}prop;\oplus NYC\text{-}res}(x) = d \wedge know\text{-}neighbors(x)]\}$$

$$= max\{d : \exists x[Ithaca\text{-}res(x) \wedge \frac{\mu^c_{\#}(x)}{\mu^c_{\#}(\oplus Ithaca\text{-}res)} = d \wedge know\text{-}neighbors(x)\} \succ$$
$$max\{d : \exists x[NYC\text{-}res(x) \wedge \frac{\mu^c_{\#}(x)}{\mu^c_{\#}(\oplus NYC\text{-}res)} = d \wedge know\text{-}neighbors(x)\}$$

Crucially, the function introduced by *Meas* in the matrix clause maps pluralities of Ithaca residents to the proportion they represent of the totality of Ithaca residents, while its copy in the *than* clause correspondingly maps pluralities of NYC residents to the proportion they make up of all NYC residents. Thus as above we get the desired comparison of proportions.

2.3. Summary

In this section we have seen two possible approaches to the analysis of proportional comparatives. Both relate the reading of interest to the proportional interpretations of *many* and *few*, and both feature some mechanism for mapping individuals to scalar values that represent proportions. Where they differ is in how the required proportional scale is derived. The first analysis localizes the calculation of proportions in the semantics of *many* and *few* themselves on their proportional interpretations, one of two distinct lexical entries for these items. The second assumes a simpler and unambiguous semantics for *many/few*, with measurement instead encoded by an underspecified functional element *Meas*, which as one possibility can introduce a mapping from elements in the denotation of a nominal expression to a degree representing their proportion of the totality of such entities. Both of these analyses are able to capture the facts seen so far. In the remainder of the paper we will examine how they fare in accounting for a wider range of data. Previewing the findings, we will see that only the measurement-based analysis provides a satisfactory explanation for certain facts relating the the distribution of proportional expressions and proportional interpretations.

3. The semantics of percent

Words such as *many* are of course not the only sorts of expressions with a proportional meaning, the other obvious case being those of the form *n percent*, as in the following:

(26) a. Twenty percent of the students wrote papers.
b. Sixty percent of the wine we sell is German.

There is surprisingly little work on the semantics of such relative or proportional measures, notable exceptions being Ionin et al. (2006) and more recently Ahn and Sauerland (2015, 2017). The latter authors propose the following as the lexical entry for *percent*:

(27) $$[\![percent]\!] = \lambda x_e \lambda n_d \lambda P_{et}.\left[\frac{\mu(x \sqcap \oplus P)}{\mu(x)} = \frac{n}{100}\right]$$

On this analysis, examples such as (26) do not involve the direct measurement of proportions. Rather, the measure function μ maps entities to values on ordinary quantity scales. In (26a), for example, μ is interpreted as a cardinality function; in (26b) it is a function mapping portions of wine to some appropriate measure of liquids, perhaps volume in liters. The computation of proportions itself is lexicalized by *percent*. Assuming *of* to be semantically vacuous, (26a) receives the following analysis:

(28) $$\frac{\mu_{\#}(\textit{the-students} \sqcap \oplus(\textit{individuals who wrote papers}))}{\mu_{\#}(\textit{the-students})} = \frac{20}{100}$$

Although this approach is appropriate for examples such as (26), there is reason to believe that in other cases expressions of the form *n percent* have interpretations on which they directly denote degrees. The strongest evidence for this is that they occur in the same syntactic positions as do numerals when these are analyzed as degree denoting. Three such contexts are illustrated below:

(29) a. Twenty times ten equals two hundred.
b. More/fewer than twenty of the students wrote papers.
c. We sold twenty fewer houses this year than last year.

(30) a. Twenty percent of ten percent equals two percent.
b. More/fewer than twenty percent of the students wrote papers.
c. We sold twenty percent fewer houses this year than last year.

The (a) examples above are mathematical statements, which appear to express relations between degrees. The (b) examples involve comparative quantifiers. It is common (e.g. Nouwen, 2010) to analyze the comparative morpheme in this case as a degree quantifier that takes an initial number or degree argument, as in (31). We must then conclude that *twenty percent* in (30b), just like *twenty* in (29b), can denote a degree that can saturate this argument.

(31) $[\![\textit{-er}]\!] = \lambda d \lambda I.max(I) \succ d.$

Finally, the (c) examples illustrate the differential use of measure expressions. In (29c), there is quite obviously no plurality of houses which is asserted to have cardinality twenty. Rather, the numeral describes the distance between two values on the number line; that is, the sentence is true if it holds that the difference between $|\textit{houses we sold last year}|$ and $|\textit{houses we sold this year}|$ equals 20. It seems that a parallel analysis must be extended to (30c).

Importantly, in none of the examples in (30) can *twenty percent* be given an analysis based on the proposed lexical entry for *percent* in (27). Instead, we require it in each case to be interpreted as denoting a degree, i.e. $[\![\textit{twenty percent}_d]\!] = 20\%$. This provides further evidence that we require a scale of proportion on which such degrees are situated.

Let us consider how this set of facts might be accounted for under the two approaches to proportional comparatives introduced in the previous section, each of which provides in one way or another a mapping to scalar values that represent proportions of a totality.

In the ambiguity account of Section 2.1, the calculation of proportions is part of the semantic function of the proportional versions of *many* and *few*. While we do not assume measure functions that map individuals to proportions, the first arguments of *many/few* on their proportional readings (7b), (8b) can be viewed as ranging over degrees of proportion. This leads us to predict that we will detect degrees of proportion – and expressions that refer to them – only in the presence of *many/few* (or *much/little*). This makes proportional expressions in mathematical statements such as (30a) somewhat unexpected, though we might propose to construe them as answers to covert *how* $many_{PROP}$*?* questions. Expressions of proportion in comparative quantifier examples such as (30b) can be handled by taking these to be based on comparative forms of proportional *many* and *few*, i.e. essentially the same analysis given above to proportional comparatives. But differential examples such as (30c) are problematic. The only kind of proportion that can be derived from the proportional entries of *many/few* is the proportion that a plurality represents of some totality that it is a part of. But *twenty percent* in (30c) does not have this sort of interpretation. In fact, as noted above, in this example there is no plurality whose measure is reported. Rather, the percentage expression describes the difference between two values in proportional terms. This value cannot be calculated on the basis of the proportional entry for *few* proposed in Section 2.1. It is necessary to posit some other mechanism; for example, we might start with an interpretation of the comparative morpheme that allows differential degrees (see e.g. Beck 2011), and modify it to allow these to express proportions.

Note also that an account based on proportional interpretations for *many/few* and degree-denoting interpretations for expressions of the form *n percent* does not in itself provide an analysis of simple partitive examples such as (26), because there is apparently no element present that introduces degrees of proportions. There are several ways this issue might be addressed. As one possibility, we might propose that *n percent* has a second interpretation based on Ahn & Sauerland's entry for *percent* in (27). Alternately, we might assume that such partitive examples include a covert counterpart of $many_{PROP}$, or that a comparable function is encoded in the semantics of partitive *of*. All of these potential solutions add duplication to the system as a whole; below, we will see some further issues that they present.

Now let us turn to how the same data can be handled by the measurement-based account developed in Section 2.2. Recall that on this analysis, quantity measurement is encoded by a null functional element *Meas*, which introduces a contextually determined measure function. One potential option for this function is a domain-restricted function, and more specifically a proportional one. Thus in contrast to the previous approach, this analysis assumes a measure function whose range is a scale of proportion (see Fig. 1). It is thus not surprising that there are linguistic expressions that refer to points on this scale: just as *twenty* can refer to a point on the number line and *twenty inches* to a point on a scale of height, so too can *twenty percent* refer to a point on a scale of proportion.

Degrees of this sort can form the basis for mathematical statements such as (30a), and can saturate the degree argument of the comparative quantifier version of *-er* in (31). An example such as (30b) can then be analyzed as involving degrees derived via a proportional instantiation of the measure function introduced by *Meas*, with *more/fewer* analyzed as the comparative forms of the degree quantifier entries in (16) above; again, this is parallel to the treatment of our original proportional comparative examples.

Putting aside for the moment the tricky example in (30c), let us consider proportional partitives such as (26). The simplest way to analyze such examples in the measurement-based framework is to treat partitive *of* as the overt instantiation of *Meas*. Such an approach goes back to Schwarzschild (2006), who was among the first to posit the existence of a null measuring element parallel to *of* underlying the interpretation of words of the *many* class. Specifically, we can analyze *of* in such cases as encoding a domain-restricted measure function:

(32) $[\![of]\!] = \lambda x \lambda d \lambda y.[\mu^{c}_{DIM;x}(y) = d]$

On this view, partitive *of* has a dual function, establishing the 'part of' relation (as in Ionin et al. 2006) and also associating entities with degrees.

Importantly, this approach to *of* allows an analysis of both numerical partitives such as (33a) and proportional partitives such as (33b). The first of these involves a domain-restricted measure function that maps subgroups of the relevant totality of students to a subsegment of the number line corresponding to the cardinalities of such subgroups. For example, if there are fifty relevant students, the corresponding scale segment is $[0,50]$. In the latter proportional case, the measure function is the proportional variety of a domain-restricted function, whose range is the proportions from 0% to 100%.

(33) a. Twenty of the students wrote papers.
$\mu_{\#;the\text{-}students} : x \sqsubseteq \textit{the-students} \rightarrow [0, \#\text{ of the students}]$

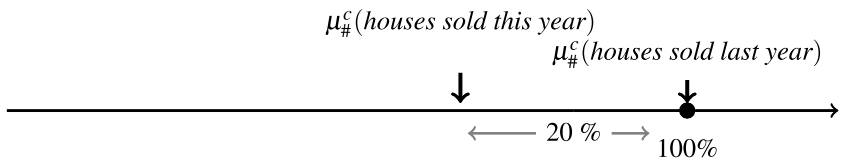
b. Twenty percent of the students wrote papers.
$\mu_{\#\text{-}prop;the\text{-}students} : x \sqsubseteq \textit{the-students} \rightarrow [0\%, 100\%]$

In both cases the domain – and therefore also the range – of the measure function is restricted. The difference is that in one case the values on the scale are construed as numbers (cardinalities), while in the other they are construed as proportions.

A nice consequence of unifying partitive *of* with *Meas* is that we correctly account for the fact that the same monotonicity constraint is present in both cases. As an example, *more copper than silver* – which we take to involve a comparative form of *much* – can describe a portion of copper that has a greater measure than the corresponding portion of silver in terms of volume or weight (both monotonic on the part-whole relation among entities), but not in terms of temperature or purity (both non-monotonic). By the same token, *twenty percent of the copper* can be a portion of copper whose measure in terms of volume or weight is 20% of that of the relevant totality of copper, but not one whose purity or temperature is 20% of that of the totality.[6] This parallel is not captured by an account on which the semantics of relative measures such as *twenty percent* are based on Ahn & Sauerland's entry for *percent* in (27), while *more* comparatives are based on generalized quantifier entries for *many/much* such as Romero's in (7).

Finally, let us return to the differential use exemplified in (30c), repeated below. While these might be handled in the same way suggested above for the ambiguity account, the measurement-based analysis offers another possibility. Recall that the semantics of $Meas$ is underspecified: both the dimension of measurement and the particular scale tracking that dimension are contextually determined. Even when the dimension is set to be cardinality or number, there are multiple possible scales and corresponding measure functions. One such function is that which maps the totality of houses sold last year to the point 1 (or equivalently 100%), and other pluralities to values expressed in relation to this. In (30c), *twenty percent* describes the length of an interval on this scale:

(34) We sold twenty percent fewer houses this year than last year. (=(30c))



Note that the measure function here is not a proportional one (or for that matter a domain-restricted one of any sort); but it satisfies monotonicity, making it a licit choice.

To summarize, in this section the inquiry has been extended to include expressions of the form *n percent*. Contrary to the predictions of some current theories, it has been seen that certain uses of such expressions must be analyzed as degree denoting, thus providing further evidence for the existence of proportional scales. The measurement-based theory can handle these uses via the same mechanisms applied to proportional comparatives, while assuming a single degree-denoting entry for *n percent*. The ambiguity approach instead requires some sort of duplication to be added to the system, i.e. distinct interpretations for *n percent*, or multiple loci for the computation of proportions. Perhaps the most parsimonious enhancement to this account would be to assume a null proportional *many* in proportional partitives. Below it will be shown that this does not get the facts right.

4. Cardinal readings, proportional readings and their distribution

In this section we will examine more directly the proposal that *many* and similar words are actually lexically ambiguous between cardinal and proportional interpretations, and compare this view to one in which their different readings arise instead from underspecification in measurement, in conjunction with a distinction between ordinary and domain-restricted measure functions. The question to be addressed is which of these approaches best captures the distribution of the two readings in question.

[6] For related discussion on dimensions available in partitive constructions, see Krifka 1989.

The first observation to be made is that the availability of distinct cardinal and proportional readings for words of the *many* class is not an idiosyncratic fact about English: a similar 'ambiguity' has been documented for the corresponding forms in languages including German (Kobele and Zimmermann, 2012), Dutch (Ruys, 2017), Slovenian (Stateva and Stepanov, 2017), Basque (Etxeberria, 2008), Japanese (Tanaka, 2006) and Hausa (Zimmermann, 2008) (though Russian distinguishes the two meanings lexically; see Krasikova 2011). On an account that treats this as a lexical ambiguity, one would need to claim that the same essentially accidental pairing of meanings with a single surface form has arisen in a range of typologically unrelated languages, an unlikely situation. On the measurement-based approach a more general account suggests itself: the availability of the two interpretations derives from the interaction of the lexical semantics of vague quantity words with the semantics of quantity measurement, which we might propose to universally come in domain-restricted and non-restricted varieties. To further develop this idea, it would be beneficial to investigate in more depth the facts relating to proportional measurement cross-linguistically.

Returning to English, a second important observation is that cardinal and proportional readings are not universally available; rather, their distribution is constrained by both syntactic and semantic factors. One of these relates to predicate type. In particular, Milsark (1977), Partee (1989) and others have observed that in combination with individual-level predicates (Carlson, 1977) *many* and *few* allow only the proportional reading, and not the cardinal one. As discussed above, the availability of the cardinal interpretation is most easily diagnosed in the case of *few*. Recall that (6), repeated here as (35), is felicitous, evidence that the sentence has a cardinal reading on which *few Ns* can be all of the *Ns*. But when the stage-level predicate *identified in our survey* is replaced by the individual-level *suckle their young* in (36), the same continuation is infelicitous, indicating that only the proportional reading is available.

(35) Few egg-laying mammals were found in our survey, perhaps because there are few.
(36) Few egg-laying mammals suckle their young, #perhaps because there are few.

I cannot claim to offer a fully developed account of the source of this restriction, but one can imagine how this pattern might be approached from the perspective of the two analyses discussed in Section 2. On the ambiguity view, we might say that (for whatever reason) only the proportional entries for *many/few* can select an individual-level predicate as their second argument. On the measurement-based approach, the proposal would instead be that in the presence of such a predicate, the measure function introduced by *Meas* is necessarily of the domain-restricted variety; this might be related to a proposal by Ladusaw (1994) that such predicates participate in two-stage categorical judgments (Kuroda, 1972), in the first stage of which the judge's attention is drawn to an individual to which the predicate will be associated (see Solt 2009 for discussion).

Crucially, these two approaches make different predictions regarding the readings available to proportional comparatives. Consider again our original examples, repeated below:

(1) More residents of Ithaca than New York City know their neighbors.
(2) More Norwegians than Brazilians have university degrees.

Both of these feature individual-level predicates, and as such it is not surprising that they have proportional readings. But both also clearly have (false) cardinal readings, where it is absolute numbers of Ithaca vs. NYC residents and of Norwegians vs. Brazilians that are compared. On the ambiguity analysis, augmented as suggested to account for the facts relating to predicate type, this reading cannot be derived: if *more* in quantity comparatives is analyzed as the comparative form of *many*, and only the proportional version of *many* can surface with individual level predicates, then we predict only the proportional reading for these examples.

In the measurement-based account, a different picture emerges. Suppose, as suggested above, that in the presence of an individual-level predicate the measure function is necessarily a domain-restricted one $\mu_{DIM;\oplus P}$. As was demonstrated in Section 2.2, when this is interpreted in particular as a proportional measure function (Fig. 1c), we derive the proportional reading of the comparative. On the other hand, if it is interpreted as an 'ordinary' domain-restricted function (Fig. 1b), which maps pluralities to some bounded segment of the number line, the cardinal reading of the comparative results. But in either case, the standard range introduced by the positive morpheme *POS* is necessarily situated on the bounded segment of the scale (see the diagram in (23) above). As a result, bare *many* in a corresponding positive example such as (36) must be interpreted proportionally. That is, in the case of a domain-restricted quantity measure, we derive only the proportional reading of the unmodified positive form, but both cardinal and proportional readings of the comparative.

A second context in which only the proportional reading of *many/few* surfaces is the partitive (Milsark, 1977; Partee, 1989), and here again we observe a divergence between the positive and comparative. By way of example, (37) is false in a situation in which there <u>are</u> only a small number of first-year students and they all wrote papers, evidence that *few* must be interpreted proportionally. By contrast, (38) seems to allow a proportional reading, on which it is proportions of first- and second-year students that are compared; but it also fairly clearly has a cardinal reading, which expresses that the absolute number of first-year students who wrote papers is larger (smaller) than the corresponding number of second year students who did.

(37) Few of the first year students wrote papers.
(38) More/fewer of the first year students than the second year students wrote papers.

On the measurement-based analysis, this can be accounted for in the same way as with individual level predicates. Partitive *of* is analyzed as having a domain-restricted measure function as part of its semantic content (see (32) above), which necessarily yields a proportional reading for bare *many/few* due to a constraint on the scalar position of the threshold, but yields both readings of the comparative, depending on whether or not the measure function is specifically a proportional one. And with the ambiguity analysis, we run into the same issue that we did above: if only the proportional versions of *many/few* can occur with the partitive, we predict only the proportional reading of the corresponding partitive comparatives, a prediction that is not supported by examples such as (38).

Note that the issue for the ambiguity analysis also extends to numerical partitive constructions such as *twenty percent of the students*. Recall that one way to approach these from the perspective of the ambiguity analysis would be to assume they include a null version of proportional *many* that introduces degrees of proportion to which an expression such as *twenty percent* can refer. But if we make the reasonable assumption that this null *many* obeys the same constraints as the overt one, specifically that in the partitive construction it must be interpreted proportionally, we seem to predict that only proportional measures will be possible, which is contradicted by examples such as *twenty of the students*. As discussed in Section 3, the measurement-based account can generate both absolute and proportional measures in partitives.

To summarize, we have seen two contexts in which there is a divergence in the interpretations available to positive and comparative forms: the former are necessarily interpreted proportionally, while the latter can but need not have this interpretation. This pattern is problematic for an ambiguity analysis of the form presented in Section 2.1, but not for the measurement-based approach of Section 2.2, because the latter offers a mechanism that the ambiguity approach does not, namely the possibility of quantity measurement that is relative (to a suitable totality) but not explicitly proportional.

Here a reader might object that the ambiguity analysis could be modified to address this objection, by incorporating the same semantic mechanism proposed to underlie the measurement-based account, and then replacing Romero's entries for cardinal and proportional *many* with something along the lines of the following:

(39) a. $[\![many_{CARD}]\!] = \lambda d \lambda P_{\langle et \rangle} \lambda Q_{\langle et \rangle} . \mu_{\#}(P \cap Q) \succeq d$
b. $[\![many_{PROP}]\!] = \lambda d \lambda P_{\langle et \rangle} \lambda Q_{\langle et \rangle} . \mu_{\#;\oplus P}(P \cap Q) \succeq d$

This is certainly true, but with this change, the difference between the two analyses reduces essentially to one of semantic type. On one approach (the 'ambiguity' analysis), *many* and like words are ambiguous between two quantifying determiners that differ in whether the measurement they encode is unrestricted or domain restricted (or we might even take them to have a single underspecified meaning that encompasses both possibilities). On the alternate approach (the 'measurement' analysis), an equivalent underspecification or ambiguity is localized in the semantics of a null measuring element (sometimes spelled out as *of*), while *many* words have a single simple interpretation as gradable predicates of sets of degrees. The data that would adjudicate between these two options falls outside the scope of the present paper; but as alluded to earlier, there are reasons to favor the degree-based analysis over the generalized quantifier approach, in that it allows a more general account of these items across the range of contexts in which they occur (see Solt 2015 for discussion). In any case it must be concluded that with regards to capturing the availability of distinct cardinal and proportional readings for *many* etc., the generalized quantifier approach does not have an advantage over the degree-based one.

5. Conclusion and Open Issues

The starting point for this paper was the proportional reading of quantity comparatives, which poses a challenge for a degree-based semantic framework. I have argued for an analysis based on the notion of domain-restricted and more specifically proportional measure functions, which map individuals to degrees that encode the proportion they represent of some totality they are part of. It has been demonstrated that this mechanism can be extended also to other sorts of proportional expressions, and that it offers advantages over an alternate approach based on explicitly proportional entries for gradable quantity words such as *many* and *few*. The conclusion is that proportional scales, and the corresponding measure functions, are a necessary part of the degree ontology. A secondary finding is that it is no longer necessary to analyze words of the *many* class as lexically ambiguous, a satisfying result given that the purported ambiguity is present in a range of typologically diverse languages.

At this stage there are, to be sure, some fairly significant questions left open. In that the account presented here depends crucially on underspecification in the linguistic encoding of quantity measurement, it faces the issue of overgeneration. As one aspect of this, we do not have an explanation for the observation (see e.g. Bale and Barner, 2009) that the default dimension for count noun comparatives is cardinality (number): *more students than teachers*, for example, must be a greater number of students, not, say, a group of greater weight. Interestingly, though, since a comparative such as this allows a proportional reading, we must consider proportion-of-number to be a variety of cardinality measurement. Perhaps more significantly, the restriction that quantity measurement be monotonic still allows an infinite number of specific measure functions for the representation of cardinality, or any other dimension. This proved useful in developing an analysis of proportional measures in differential position (see Section 3), but also has some less desirable consequences: for example, nothing would prevent selecting a measure function that maps pluralities to a value equal to twice their 'ordinary' cardinality, such that a group consisting of three students could be described as *six students*. I do not have a concrete proposal for how this can be avoided, though I suspect it might ultimately require a distinction to be made between counting and other forms of measurement, as proposed among others by Rothstein (2017).

Note finally that the present analysis does not yet capture all uses and interpretations of proportional expressions. In particular, I have not attempted to address non-conservative 'reverse' readings, which are available for both quantity words and percentage expressions (see Westerståhl 1985; Herburger 1997; Cohen 2001; Romero 2015 for the former and Ahn and Sauerland 2015, 2017 for the latter). For example, *Many Scandinavians have won the Nobel Prize in literature* has a reading on which it is true if Scandinavians make up a large proportion of winners, and *The firm hired 75% women* means that 75% of those hired were women (not that 75% of some group of women were hired). Recent works have analyzed these with reference to alternatives generated via focus, though in different ways: Romero proposes that such alternatives form a comparison class on the basis of which the standard for proportional *many* is derived, while Ahn & Sauerland analyze them as providing a set whose measure serves as the denominator for the calculation of (reverse) proportions. I leave it to be determined whether one of these approaches could be integrated with the account of proportional measurement developed in this paper. I have sought here to unify the analysis of the proportional reading of *many/few* and proportional measures of the form *n percent*, and it would be desirable to investigate if a unified treatment of their reverse readings is likewise possible.

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Complement coercion in Polish and the role of selectional restrictions revealed in a self-paced reading study[1]

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Abstract So-called 'complement coercion' (*'begin a book'*), understood as a combinatorial conflict, is mainly analysed as a repair operation in composition. Experimental data has shown that there is an extra cognitive effort in the processing of event-selecting verbs with entity-denoting arguments. These results support the formal analysis of 'complement coercion' as an enriched form of semantic composition (Pustejovsky, 1995; Egg, 2003; de Swart, 2011; Asher, 2015). Recently, an alternative view has been proposed by Piñango and Deo (2015) arguing that there is no mismatch between the verb and its complement, but an ambiguity resulting from the different dimensions along which an aspectual verb in composition with its argument can be interpreted (e.g. temporal, spatial, etc.). This approach has been supported by experiments showing that aspectual verbs like *begin* incur greater processing cost in coercing contexts than psychological verbs like *enjoy* (Lai et al., 2014). We designed a self-paced reading experiment to compare the different predictions that the two approaches make for the processing of matching and mismatching verb-noun combinations. Our results are compatible with enriched composition, but not with dimensional ambiguity. We find facilitation in conditions where the selectional restrictions of the verbs are satisfied (*'begin a fight', 'see a book'*), and longer processing times in the conditions *'begin a book', 'see a fight'*, which does not support the dimensional ambiguity approach. Our experiment thus provides evidence that selectional restrictions are a fundamental property of a predicate and that they need to be understood as a graded continuum of combinatorial preferences, as also argued in Spalek (2014).

Keywords: Complement coercion, aspectual verbs, real-time processing, self-paced reading.

1. Introduction

The minimal pair in (1) presents a challenge for the compositional derivation of meaning: in (1a) the verb *start* combines with an event-denoting complement, in (1b) with an entity-denoting complement. In the first case, the event is explicitly referred to, in the second, we can only infer that an event involving the soup was started. Cases like (1b) exhibit so-called 'complement coercion' – an operation by which the verb 'coerces' its semantically mismatching object to the appropriate semantic type.

(1) a. The boy started the fight.
b. The boy started the soup.

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This contrast imposes the following consideration to be accounted for theoretically: given that the verb *start* presupposes an argument of eventuality type, predication in example (1b) should go wrong, because it seems that there is a conflict between the demands of the predicate on the type of its argument and the argument the predicate actually gets. Yet the sentence (1b) is interpretable and can refer to an event of soup eating or soup cooking, etc. Any compositional theory of meaning needs to account for the means by which a predicate like *start* can compose both with an eventuality-denoting noun, e.g. *fight* in (1a), and with an individual-denoting noun, e.g. *soup* in (1b). 'Complement coercion' thus raises a very general question of conceptual knowledge and how it is supposed to interact with referential semantics.

Crucially for our study, the verb *start* in the minimal pair in (1) contrasts with verbs such as *see, criticize* or *prepare*, which prima facie combine easily with both kinds of noun phrases, event nouns and individual-denoting nouns. Many studies classify verbs like *start* as 'aspectual verbs' and show that they typically allow for 'complement coercion'. The verbs in (2), in contrast, are classified as non-aspectual verbs, but not much has been said about their selectional restrictions so far.

(2) a. The man saw/ criticized/ prepared the fight.
 b. The man saw/ criticized/ prepared the soup.

The present study explores the combinatorial compatibility of the two kinds of verbs, aspectual verbs (1) versus non-aspectual verbs (2), with eventuality-denoting and individual-denoting arguments. Comparing the ease of processing of the different verb-noun combinations, we obtained contrasts indicating the complexity of semantic processing during real-time comprehension, which we argue have concrete implications for the models of meaning based on the idea that predicates select their arguments. We designed two self-paced reading studies that contrast aspectual verbs with non-aspectual verbs (henceforth, 'AV(s)' and 'N-AV(s)') using Polish. Polish seemed particularly interesting for our purpose, because it has two kinds of entity-denoting nouns that differ in their morphology, one of them being morphologically non-transparent and another containing a verbal root. The latter allowed us to manipulate the 'coercion effect' in one of the experiments.

Before advancing, we introduce a terminological clarification. Since the term 'complement coercion' is widely accepted in the literature on AVs to refer to the combinations where an AV takes an individual-denoting DP, we will refer to these combinations as 'coercing contexts' and to the group of verbs as simply 'coercing verbs', without correlating these terms with any particular theoretical account.

2. On complement coercion

Coercing verbs, like *enjoy, begin, start, finish, stop*, etc., have been extensively discussed since Pustejovsky (1991), and their capacity to take an individual-denoting noun as a complement, so-called 'complement coercion' (1b), has been the object of a rich theoretical discussion (Pustejovsky, 1995; Copestake and Briscoe, 1995; Fodor and Lepore, 1998; Egg, 2003; de Swart, 2011; Asher, 2011). The common denominator of these well-known accounts has been to take complement coercion as a semantic type mismatch between the selectional requirements of the predicate and its argument. Diverse solutions have been proposed as to how the missing specification of the event is recovered (e.g. in (1b) it could be either an eating or a cooking event depending on the context). Pustejovsky (1995) posits a complex lexical entry for the argument which is able to give access to the event reading. Fodor and Lepore (1998), on the other hand, propose that the event-reading results from post-lexical inferences, while many others advocate for some kind of enriched form of composition (Egg, 2003; de Swart, 2011; Asher, 2011). In some cases, the enriched process of composition comes together with the assumption that the lexicon is underspecified, as in Egg (2003); in other cases, certain lexical units, such as AVs, license dependent types that trigger a repair process during composition (Asher, 2011).

Abstracting away from the formal details, these approaches share the assumption that AVs determine the semantic type of their arguments and that to satisfy those semantic requirements some operation needs to be performed to 'coerce' the entity-denoting complement into the appropriate semantic type. We will refer to this as the Enriched Semantic Composition hypothesis following the terminology proposed in lexical-semantic research (Pustejovsky, 1991, 1995; Jackendoff, 1997). This hypothesis finds support in various kinds of experimental results (McElree et al., 2001; Traxler et al., 2002, 2005; McElree et al., 2006; Pylkkänen and McElree, 2007; Frisson and McElree, 2008; Kuperberg et al., 2010), which have shown that combining a coercing verb with an entity-denoting complement (1b) during real-time comprehension engenders more processing cost than combining it with an event-denoting complement (1a).

More recently, taking a special focus on entity-denoting complements of AVs, Piñango and Deo (2015) called the type-mismatch analysis into question by observing that there is a whole range of combinations of AVs and individual-denoting nouns that represent configurational relations. In combinations such as in (3), Piñango and Deo (2015) observe that there is no need for coercion and propose that these cases are prevalent, rather than exceptions. This observation leads them to develop a generalized lexical semantics for AVs that dispenses with coercion.

(3) This is the famous perch that officially begins the Appalachian Trail.
((7d) in Piñango and Deo (2015))

Based on the idea of generalized paths (Gawron, 2009), Piñango and Deo (2015) propose a unifying lexical semantics for AVs, where AVs specify relations between the sub-parts of the axis determined by their complements' denotation. On this account AVs presuppose their arguments to be structured individuals with respect to a contextually determined function in some domain. AVs thus make reference to parthood relations formalized as contextually defined functions, e.g. a spatial trace function in the case of example (3). With this analysis Piñango and Deo (2015) argue that what has been called 'complement coercion' can be explained as a case of ambiguity between the different dimensions that a particular AV can access. An interesting example to illustrate this account in more detail is (4).

(4) The little girl began the queue. ((29a) in Piñango and Deo (2015))

According to Piñango and Deo (2015), the interpretation of a sentence containing an AV, such as *begin* in (4), is dependent on determining the specific dimension along which the denotation of the complement is structured. (4) is thus ambiguous and can be paraphrased either as 'The little girl began forming the queue' (temporal dimension) or as describing the position of the little girl relative to the structure of the queue (spatial dimension). Examples of this kind lead Piñango and Deo (2015: 14) to conclude that 'any analysis of aspectual verbs that assumes that they select for event-denoting complements is not tenable'.

This approach crucially assumes that AVs do not impose restrictions on the type of their arguments, but rather establish 'parthood relations between objects along a range of familiar (and, sometimes not so familiar) dimensions' (Piñango and Deo, 2015: 10). The processing cost in experimental studies can, therefore, be attributed to the need of identifying the appropriate dimension for the interpretation of an AV and its complement. This proposal finds support in studies showing that only a subset of coercing verbs engender additional processing cost, namely strictly AVs, such as *begin, start*, etc., but not psychological coercing verbs, such as *enjoy, prefer* (Katsika et al. (2012), Lai et al. (2014)). We will refer to this approach as the Dimension Ambiguity Hypothesis.

The Enriched Composition approach predicts that during real-time sentence processing AVs create strong expectations for the semantic type of their arguments. The Dimensional Ambiguity hypothesis, on the other hand, makes no assumptions about selectional restrictions and predicts that the ease of the identification of a temporal dimension for the interpretation of the entity-denoting complement will affect the ease of the processing of coercion contexts. In the absence of ambiguity between dimensions (with N-AVs and their complements), no processing costs should be observed. We measured the processing cost in terms of reading times, and our experiment was designed on the basis of prior reading studies on complement coercion. In the next section we present prior experimental results that guided the design of our study in order to test the two different approaches to AVs and their selectional properties.

3. Differences in reading times

The processing cost of complement coercion, (1b) in contrast to (1a), was first shown in the self-paced reading and eye-tracking during reading experiments of McElree et al. (2001) and Traxler et al. (2002). In a self-paced reading experiment participants read the sentences presented on the computer screen chunk-by-chunk, advancing at their own pace (Just et al., 1982). The times of each button press to move to the next chunk are recorded, and longer reaction times (RTs) are interpreted as reflecting a higher level of processing difficulty. Using self-paced reading, McElree et al. (2001) tested the basic question whether AVs, like *start* in (5a), are more difficult to process than N-AVs, like *write, read* in (5b)-(5c). They compared the reading times at the noun complement and at the following adverbial in three conditions: coercion context (5a), preferred combination (5b) (the verb explicitly expressed the event) and non-preferred combination (5c) (the verb explicitly expressed a less frequent but plausible event).[2]

[2]Ratings for the preferred and non-preferred verb-noun combinations were obtained in a separate norming study.

(5) a. The author was starting the book in his house. – Coercion
b. The author was writing the book in his house. – Preferred
c. The author was reading the book in his house. – Non-preferred

They found that while the non-preferred verb-noun combinations elicited longer RTs than the preferred ones, there was an extra cost associated with the coercion contexts. (The reading times were measured both at the target (noun) and post-target (adverbial) regions, because the processing of the target region affects the processing of the following regions. The RTs at the target noun were significantly longer in the coerced and the non-preferred conditions than in the preferred condition. The RTs at the adverbial were significantly longer in the coerced condition than in both the preferred and the non-preferred conditions.)

Traxler et al. (2002) further tested the nature of the processing delay using self-paced reading and eye-tracking during reading methodologies. While in a self-paced reading experiment segments must be presented sequentially, in an eye-tracking experiment natural reading is possible and different measures of the processing cost are available (e.g. total reading times for a region, just like in self-paced reading, but also the time spent reading a word for the first time, re-reading it again, etc.). They investigated whether the effects found by McElree et al. (2001) could be caused by the fact that while *start* has a preference for a verbal complement, it receives a nominal complement in (5a). Their test items involved quadruples of sentences such as (6) and (7). The pair in (6) contains an AV combined with a matching event-denoting noun (6a) and with an entity-denoting noun that requires coercion (6b). In pair (7) a N-AV is combined with an entity-denoting noun (7a) and with an event-denoting noun (7b).

(6) a. The boy started the fight after school today. – No Coercion (AV, EventN)
b. The boy started the puzzle after school today. – Coercion (AV, EntityN)

(7) a. The boy saw the puzzle after school today. – No Coercion (N-AV, EntityN)
b. The boy saw the fight after school today. – No Coercion (N-AV, EventN)

The results of both experiments, the eye-tracking study and the self-paced reading experiment, indicated that the complement coercion condition, (6b), incurred extra processing cost. The self-paced reading data showed no significant differences at the target noun region like in the McElree et al. (2001) study. At the adverbial region, there was a main effect of NP-Type (EntityNs received longer RTs than EventNs) and a significant interaction: sentences with AVs and EntityNs, (6b), generated longer RTs than sentences with N-AVs and EntityNs, (7a). This means that the RTs at the adverbial were the slowest in the AV+EntityN condition, (6b). Of interest to our study, as will be explained in section 4, is also the result that sentences with AVs and EventNs, (6a), had numerically (not significantly) shorter RTs than sentences with N-AVs and EventNs, (7b).

The eye-tracking data revealed reading differences already at the noun region, with the coercion condition (6b) being the hardest. Crucially, the measures that are typically considered to reflect integrative processing in eye-movement data ('second pass time'[3] and 'total time') revealed that at the noun region EntityNs were harder to process with AVs – there was a main effect of NP-Type and a significant interaction. Second pass time and total time are later measures which can explain the lack of effects on the noun in their self-paced reading study. Moreover, at the noun, in the second pass time data, the RTs in the AV+EventN condition, (6a), were numerically lower than in the N-AV+EventN condition, (7b) – though this difference was not significant, just like in the self-paced reading experiment, we take this finding into account for the design of our study, as explained below (section 4).

The Traxler et al. (2002) study provided evidence that AVs with EntityNs are costly to process. It did not yield statistically significant results indicating that AVs create an expectation for EventNs during processing, but in both of their experiments there was clearly such a trend (EventNs received faster RTs after AVs than N-AVs). The goal of our study was to confirm that coercion contexts require extra processing cost in Polish, and to find out what causes this extra cost: (i) the verb and its selectional restrictions (Enriched Semantic Composition) or (ii) the noun interpreted as a structured individual (Dimension Ambiguity). We based our experimental design on Traxler et al. (2002), but structured the whole experiment in such a way that we could take advantage of two different classes of nouns in Polish that allowed us to manipulate both coercion contexts and the properties of the complement nouns, as presented in the next section.

4. The present study

We designed a self-paced reading experiment to compare the different predictions that the Enriched Composition approach and the Dimension Ambiguity approach make for the processing of matching and mismatching verb-noun combinations. The two approaches make different predictions for (i) the processing AV+EventN combinations in contrast to N-AV+EventN, and for (ii) the processing of those EntityNs that are morphologically non-transparent and those that contain a verbal root.

The first contrast follows from the fact that, as discussed in section 2, the Enriched Composition approach, but not the Dimension Ambiguity approach, assumes that AVs select for event-denoting complements. This predicts that during incremental processing, when the parser encounters an AV, an expectation for an event-denoting complement is created. In contrast, N-AVs, which can select for both entity- and event-denoting arguments, should not create such an expectation during parsing. Accordingly, AVs but not N-AVs should display a bias for EventNs in processing. The Dimension Ambiguity, on the other hand, predicts the absence of such a bias, because AV+EventN combinations are simply unambiguous, just like N-AV+Entity/EventN combinations. As noted above in section 3, in the two experiments in Traxler et al. (2002) there was a trend towards AVs facilitating EventNs (not statistically significant), therefore we hypothesized that we could increase the sensitivity of the parser to the contrast between AVs and N-AVs by increasing our participants' exposure to coercing contexts.

[3]Second pass time includes all of the time spent in the region following first-pass fixations and the time at second access after exiting the region to the left or right

The second set of predictions where the two theories diverge follows from the assumption of the Dimension Ambiguity approach that EntityNs as complements to AVs are interpreted as structured individuals. During processing, the parser must choose the contextually relevant dimension along which the individual is structured, so when several dimensions are available the parser must resolve the ambiguity. We know from reading experiments on lexical ambiguity that 'balanced' and 'biased' ambiguous words are processed differently (Rayner and Duffy, 1986). Biased ambiguities are those where the two meanings are asymmetric in their likelihood, such that one meaning is dominant and the other subordinate (e.g. *ball* 'a spherical object', 'a social gathering for dancing'), though the context can reverse which of the meanings is the dominant one. In balanced ambiguities both meanings are equally available. Rayner and Duffy (1986) found that within a sentence balanced ambiguous targets were read slower than biased ambiguous targets, but in the post-target region there was an additional cost with biased ambiguous words. Thus, the two types of ambiguities received clearly different processing profiles. Accordingly, we hypothesized that we should find such different processing profiles with EntityNs biasing a temporal dimension and with EntityNs that are balanced. Polish provided us with two types of EntityNs that differed in the likelihood of a temporal interpretation: morphologically simple nouns denoting physical objects and morphologically complex nouns containing a verbal root.

The two sets of predictions were tested as two sub-experiments of one study. This combined presentation allowed us to expose our participants to a wide variety of coercion contexts, which, as noted above, was hypothesized to increase the parser's sensitivity to the different selectional requirements of AVs and N-AVs. In effect, 25% of all the sentences in the whole experiment involved coercion contexts. We discuss the predictions, materials and results for each of the sub-experiments in turn.

4.1. Sub-Experiment 1

The goal of the experiment was two-fold. First, we wanted to replicate the results of Traxler et al. (2002) by finding evidence for the processing cost of AV+EntityN combinations in Polish. Second, we wanted to test whether AV+EventN combinations facilitated processing relative to N-AV+EventN combinations, as predicted by the Enriched Composition approach. If AVs create an expectation for an eventuality-denoting complement, AV+EventNs should be easier to process than N-AVs which do not create expectations for one specific type of complement. Accordingly, we predict a three-way distinction in the processing cost:

(8) AV+EntityN > N-AV+EntityN/EventN > AV+EventN
'begin book' > 'see book/fight' > 'begin fight'
type mismatch > no specific requirement > requirement satisfied

The Dimensional Ambiguity approach, on the other hand, predicts a two-way contrast – between the AVs+EntityN combination, which requires the resolution of dimension ambiguity, and the other three combinations, where there is no ambiguity to resolve:

(9) AV+EntityN > N-AV+EntityN/EventN, AV+EventN
'begin book' > 'see book/fight', 'begin fight'
dimension ambiguity > no ambiguity

Since an AV merely requires that its argument is a structured individual with respect to a contextually determined dimension, in the combination AV+EventN, the noun is unambiguously interpreted along the temporal dimension. Therefore, the Dimensional Ambiguity analysis does not predict differences in the processing of AVs with EventNs and N-AVs with either kind of complement.

4.1.1. Materials and procedure

We used the Polish adaptations of the 24 items from Traxler et al. (2002) in the same four conditions as in (6) and (7): AV+EntityN, AV+EventN, N-AV+EntityN, N-AV+EventN. We used the AVs listed in (10)[4] and the N-AVs listed in (11).

(10) **Aspectual verbs** selecting event denoting complements:
zacząć (begin)×4; *rozpocząć* (begin)×4; *skończyć* (finish)×4; *ukończyć* (finish)×2; *zakończyć* (finish)×2; *przerwać* (pause)×2; *wytrzymać* (endure)×2; *oczekiwać* (await) ×2

(11) **Non-aspectual verbs** taking both entity- and event-denoting complements:
zobaczyć (see)×4; *skrytykować* (criticize)×2; *przygotować* (prepare)×2; *pochwalić* (praise)×4; *zignorować* (ignore)×2; *obejrzeć* (watch)×2; *opisać* (describe)×4; *wspomnieć* (mention)×2

In addition to the 24 experimental items, the participants (*n*=36, all native speakers of Polish, students from the University of Wrocław) saw the 24 items from Sub-Experiment 2 and 24 unrelated fillers containing the comparative construction (e.g. *'The daughter downloaded more games on the home computer than the son.'*)

The self-paced reading experiment was conducted using the Linger program (Rohde (2001), `http://tedlab.mit.edu/~dr/Linger/`) in a moving-window paradigm. The whole sentence was initially presented with all the words masked by dashes. Participants pressed the space bar to reveal a phrase (consisting either of a single word, a compound word or a preposition and a word), and when the new phrase appeared, the previous phrase was masked again (non-cumulative presentation). Half of the sentences in the experiment were followed by a 'yes/no' question testing comprehension. The Linger program distributed the items (from both sub-experiments) and the fillers into four lists and randomized the order of presentation of sentences within each list for each participant. Each list contained 72 test and filler sentences. The experiment took about 30 min to complete.

[4]Following Traxler et al. (2002) we included the verb *forget*, but after the experiment was conducted, we realized that it can create a coercion context. When you forget an article, you either forget what it was about or you forget the action of taking/bringing it. As a result, we did not include the two items with *forget* in our statistical analysis.

4.1.2. Data analysis

Data from participants with at least 70% accuracy on the comprehension questions, (n=35), was analyzed. None of the participants' mean reading time was more than 2.5 standard deviations from the participant mean. For reading time data analysis, we used the two-step model of Jaeger et al. (2008), Hofmeister (2011); Hofmeister et al. (2013), where first residual reading times are obtained and then those are used for the statistical analyses.[5] We removed the outlier RTs below 200ms and above 4000ms, which represented 0.33% of the experimental and filler data, and used the Box-Cox procedure (Box and Cox, 1964) to determine that the reading times should be log-transformed to meet the assumption of the linear model that residuals be normally distributed (see Baayen and Milin (2010) and Vasishth et al. (2013) a.o. for arguments that the normality assumption is important for reaction time data, whose distribution is positively skewed). For each subject we computed residual reading times to account for the differences in: (a) kind of stimulus (Sub-Experiment 1 and 2, fillers), (b) word length (because there is no linear relationship between the number of characters in a word and the required reading time), (c) word position in a sentence (because it also has no linear effect on reading times) and (d) the log-transformed trial number (because readers speed up as the experiment progresses). The residual reading times correct for these individual differences between participants' reading speeds (e.g. Ferreira and Clifton (1986), Trueswell and Tanenhaus (1994)). Statistical analyses were carried out over the residual reading times without further trimming using linear mixed-effects models in R (version 3.3.2; R Core Team (2016)) with the lme4 package (version 1.1-12; Bates et al. (2015)). We report the results of linear mixed effects models with a fully specified random effects structures (including random intercepts and for all fixed effects by participants and by items, Barr et al. (2013)); in case of convergence failures the random effects structure was simplified following Baayen et al. (2008). The p-values were obtained using the Satterthwaite approximation implemented in the lmerTest package (Kuznetsova et al., 2016).

4.1.3. Results

We found no differences in reading times at the subject and verb regions (see the plot in Figure 1). At the object noun region, there was a significant interaction between Verb-Type and NP-Type ($\beta = -.11$, $SE = .047$, $t = -2.357$, $p = .02$). AVs were faster with EventNs ($-.009$ vs. .03) while N-AVs were faster with EntityNs ($-.025$ vs. .046).

At the region of the adverbial, we found both a highly significant interaction ($\beta = -.13$, $SE = .04$, $t = -3.283$, $p = .001$) and main effects of Verb-Type ($\beta = .01$, $SE = .028$, $t = 3.547$, $p = .0004$) and NP-Type ($\beta = .075$, $SE = .028$, $t = 2.668$, $p = .008$). As can be seen in the plot, at the adverbial, N-AVs were slower than AVs and EntityNs were slower than EventNs. A four-way comparison revealed that the AV+EventN condition (the red line in the plot) was significantly faster than both the AV+EntityN condition (green) ($\beta = .074$, $SE = .028$, $t = 2.6$, $p = .014$), and the N-AV+EventN condition (blue) ($\beta = .1$, $SE = .03$, $t = 3.348$, $p = .002$). Additionally, the N-AV+EventN condition (blue) was marginally slower than the N-AV+EntityN

[5] For the implementation in R see Jaeger's blog entry `https://hlplab.wordpress.com/2008/01/23/modeling-self-paced-reading-data-effects-of-word-length-word-position-spill-over-etc/`

condition (purple) ($\beta = -.0564$, $SE = .031$, $t = -1.802$, $p = .07$), but not significantly slower than the AV+EntityN condition (green) ($\beta = -0.025$, $SE = .033$, $t = -0.762$, $p = .45$).

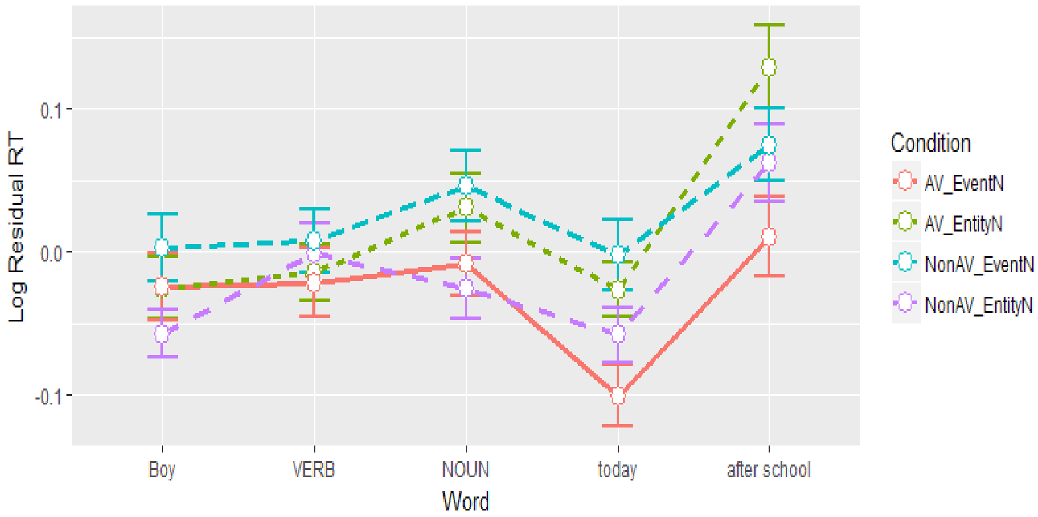


Figure 1: Sub-Experiment 1. Average Log-Transformed Residual Reading Times.

At neither the noun nor the adverbial region was the AV+EventN condition (red line) significantly different from the N-AV+EntityN condition (purple) ($\beta = .044$, $SE = .028$, $t = 1.572$, $p = .12$, $\beta = .04$, $SE = .031$, $t = 1.385$, $p = .18$). For the four-way comparison we used simple contrast coding with AV+EventN as the baseline because the theory predicts that AVs select for EventNs, hence the satisfaction of selectional requirements in this condition can account for the faster reading times seen in the results. The fact that EventNs were significantly faster with AVs than with N-AVs suggests that a processing cost was associated with the N-AV+EventN combination. This indicates that N-AVs in our experiment biased EntityN complements just like AVs biased EventN complements.

4.1.4. Discussion

At the region of the adverbial, we found the two-way contrast in (12). This result is compatible with the predicted three-way contrast in (8), but not the two-way contrast in (9) predicted by Dimensional Ambiguity hypothesis, because the two conditions that receive longer reading times, AV+EntityN and N-AV+EventN, do not form a class on the Dimensional Ambiguity theory.

(12) AV+EntityN , N-AV+EventN > AV+EventN, N-AV+EntityN
‘begin a book’, ‘see a fight’ > ‘begin a fight’, ‘see a book’

The faster reading times with both, AV+EventN and N-AV+EntityN, suggest that in both cases processing might be facilitated by the fact that the parser encounters what it expects, that is, the complement whose type matches the selectional restrictions of the predicate. What we can conclude from the bias for EntityNs after N-AVs is that N-AVs select for EntityNs as their ‘preferred’ arguments in contrast to EventNs.

Notably, the predicted 3-way contrast in (8) also involves a slow-down for the AV+EntityN condition, which we did not find, as opposed to Traxler et al. (2002). The AV+EntityN condition (green) and the N-AV+EventN condition (blue) did not differ: they were both significantly slower than the AV+EventN condition (red). This null result means that in our experiment coercion was no more costly than the combination of N-AVs with EventNs. We have just said that N-AVs combine with EventNs as their 'less preferred' complements, so does our null result suggest the same for AVs with EntityNs? Given the wide range of prior experiments showing extra cost for coercion contexts beyond the cost of the dispreferred combinations (e.g., McElree et al. (2001) discussed in section 3), we speculate that the absence of the extra cost in the AV+EntityN condition in our experiment results from the fact that we increased our participants' exposure to coercion contexts by combining the two sub-experiments. The processing of coercion became easier, at the same time, however, new differences became exposed, namely that both AVs and N-AVs create a bias for a particular semantic type of their nominal complement.

4.2. Sub-Experiment 2

The goal of this sub-experiment was to test the assumption of the Dimension Ambiguity approach that the EntityNs as complements to AVs are ambiguous between different dimensions along which the event could be structured. This predicts that the ease of identification of a particular dimension will affect the ease of processing of AV+EntityN combinations and that in the absence of ambiguity between dimensions, i.e., with N-AVs, no processing costs should be observed. As explained at the beginning of section 4, we compared two kinds of EntityNs available in Polish that differed in the likelihood of a temporal interpretation and thus should result in two different processing profiles. The first kind were morphologically simple nouns (SimpleNs) which denoted physical objects (e.g. *kolekcja* 'collection'), and thus should give rise to dimension ambiguity as complements to AVs vs. N-AVs. The ambiguity should elicit longer RTs already at the noun region.

The second kind were morphologically complex nouns (ComplexNs) (e.g. *zbiór* 'set', 'collection') containing verbal roots (verb: *zbier-ać* 'to collect') which also denoted entities, but in some cases could have a subordinate event-reading (we should note here that these nouns were not nominalizations, cf. *zbier-anie*). We hypothesized that ComplexNs might contrast with SimpleNs in that they would more readily allow the selection of the temporal dimension in the context of AVs. What is special about AVs on the Dimensional Ambiguity approach is that they require the identification of a particular dimension, which needs to happen with both ComplexNs and SimpleNs. With ComplexNs, however, this could be easier because the temporal dimension could be easier to access due to the verbal root (and the secondary eventive reading for some of the items). Accordingly, we should find the following three-way contrast:

(13) AV+SimpleN > AV+ComplexN > N-AV+ComplexN, N-AV+SimpleN

The alternative approach, Enriched Composition, makes two kinds of predictions: nouns with verbal roots may be more ready to participate in the entity-to-event semantic shift, (14); or alternatively, the semantics of the verbal root may not be able to override the semantics resulting from the nominal morphology, (15) (this is a more compositional version of the approach).

(14) AV+SimpleN > AV+ComplexN, N-AV+ComplexN, N-AV+SimpleN
type-mismatch > type-match (assuming access to the event semantics of the verbal root of ComplexNs)

(15) AV+SimpleN, AV+ComplexN > N-AV+ComplexN, N-AV+SimpleN
type-mismatch > type-match (assuming **no** access to event semantics of the verbal root of ComplexNs)

4.2.1. Materials and procedure

We constructed 24 items in four conditions: AV+SimpleN, AV+ComplexN, N-AV+SimpleN, N-AV+ComplexN. We selected 24 SimpleN–ComplexN pairs that minimally differed in meaning. For instance *zbiór* 'set', 'collection' is usually used in reference to the mathematical object while *kolekcja* is not; both, however, can be used to refer to a gathering of valuable items, e.g., in a museum. We were able to construct 24 such pairs, and tried to match their members in terms of frequency, although this was not always possible. For example, a corpus can provide the frequency of use in the formal register, but some members in the pairs were very colloquial and frequent in everyday contexts (e.g., *jedzonko* 'goodies', 'food' has only 571 hits in the monitor corpus of Polish (`http://monco.frazeo.pl/`), whereas *potrawa* 'dish', 'plate', 'meal' has 4033 hits because it is frequently used in written recipes). In the appendix, we provide the list of the ComplexN–SimpleN pairs indicating if there is a difference in their usage frequency.

Furthermore, five of the ComplexNs have a dominant entity-reading, as well as a secondary event-reading. The latter is hardly available for those words presented in isolation, but can be made explicit by adding some minimal context (e.g., *zbiór truskawek* 'strawberry picking' or *'Zbiór twarł 2 godziny'* 'The gathering lasted 2 hours'). Those five nouns were: *zbiór* 'set', *wydruk* 'printout', *przesyłka* 'package', *okop* 'trench', *opowieść* 'story'. There were six ComplexNs which cannot have event readings, *budynek* 'building', *zapałka* 'matchstick', *rysunek* 'drawing', *rzeźba* 'sculpture', *napój* 'drink', *mrożonki* 'frozen food', as evidenced by the fact they cannot appear in the frame *'X lasted 2 hours'*. The rest of the ComplexNs denote the results of activities, e.g. *napar*, 'infusion', and if they appear in our test frame, they start denoting events but those readings are odd unless more supporting context is present.

Crucially, ComplexNs contained roots that are related to the verbs implicit in the event recovered in the coercing contexts and not any other verbs (compare how in English *'John began the queue'* refers to a queueing event, whereas *'John began the pullover'* means that John started making a garment named *pullover* and not that he started pulling the garment over himself).

We used the same set of verbs as in Sub-Experiment 1.[6] The procedure and the treatment of the data for statistical analysis was as described in section 4.1.1.

4.2.2. Results

The plot of the reading data in Figure 2 shows that already on the verb there were differences in reading times, with the N-AV+SimpleN condition being the slowest (the purple line in the plot). We found a main effect of NP-Type in this region ($\beta = .073$, $SE = .03$, $t = 2.442$, $p = .015$) and a marginal interaction ($\beta = -.08$, $SE = .043$, $t = -1.748$, $p = .08$). The main effect (the N-AV+SimpleN and N-AV+ComplexN conditions are significantly slower than the AV+SimpleN and AV+ComplexN conditions) is clearly driven by the slow reading times for the the N-AV+SimpleN condition. A four-way comparison reveals that N-AV+SimpleN (purple) condition is significantly slower than the N-AV+ComplexN (blue) condition ($\beta = -.073$, $SE = .03$, $t = -2.393$, $p = .019$) but is not significantly slower than the other two conditions. This result is mysterious because the subject and the verb in the N-AV+SimpleN and N-AV+ComplexN conditions were identical, so the reading times should be no different (as is the case in Sub-Experiment 1 – the sets of verbs in both experiments was identical).[7]

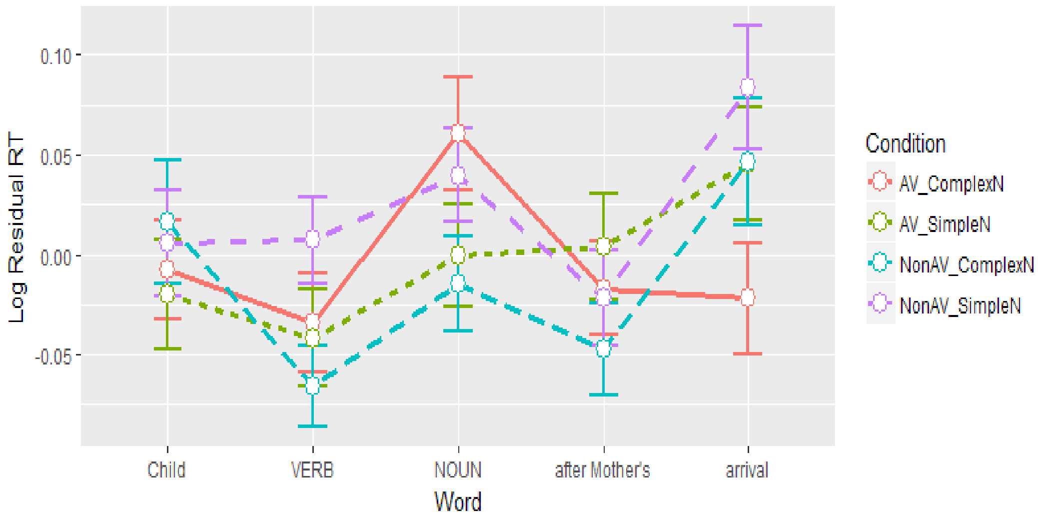


Figure 2: Sub-Experiment 2. Average Log-Transformed Residual Reading Times.

At the noun region there was a significant interaction between Verb-Type and NP-Type ($\beta = -.113$, $SE = .051$, $t = -2.212$, $p = .031$) and a main effect of Verb-Type ($\beta = .073$, $SE = .035$, $t = 2.072$, $p = .04$), but no effect of NP-Type ($\beta = .053$, $SE = .039$, $t = 1.354$, $p = .18$). A four-way comparison revealed that the AV+ComplexN condition (the red line in the plot) was significantly slower than the N-AV+ComplexN condition (blue) ($\beta = -.074$, $SE = .039$, $t = -2.129$, $p = .036$) and marginally slower than the AV+SimpleN condition (green) ($\beta = -.06$,

[6]Therefore, we needed to remove two items with the verb *forget* as explained in footnote 4. We also removed one item with a typo in the verb.

[7]We excluded the possibility that an outlier was driving this effect or that the slow-down accumulated over the course of the experiment for some reason: in Appendix A we present a boxplot and the distribution of RTs over the course of the trials showing that the RTs in the N-AV+SimpleN condition are slower at the beginning of the experiment.

$SE = .034$, $t = -1.683$, $p = .09$). This means that ComplexNs are harder with AVs than with N-AVs and that after reading an AV, a ComplexN is harder to process than a SimpleN.

At the regions of the subject and the adverbial, there were no significant differences in reading times.

4.2.3. Discussion

The experiment showed that ComplexNs are harder with AVs than with N-AVs, while SimpleNs are equally hard with both kinds of verbs (though the result that N-AV+SimpleN condition is so slow may be an artifact given the oddly high RTs at the verb). Additionally, ComplexNs are harder to process than SimpleNs following AVs. The differences in reading times can be summarized as follows:

(16) AV+ComplexN, (N-AV+SimpleN) >
(N-AV+SimpleN), AV+SimpleN, N-AV+ComplexN

The greatest processing cost occurred in the AV+ComplexN condition (red), and this condition was significantly slower than the N-AV+ComplexN condition (blue), and marginally slower than the AV+SimpleN (green). We predicted that AVs+ComplexNs would elicit the processing profile of 'biased' ambiguities (as identified in Rayner and Duffy (1986); see introduction to section 4), such that the RTs at the noun region would be faster than with SimpleNs and slower RTs would emerge at the post-target region. This prediction was not borne out, hence, we conclude that the ambiguity was not processed, possibly because the morphological complexity prevents access to the verbal root during semantic composition. Since there was no significant difference between the N-AV+ComplexN (blue) and the AV+SimpleN (green) conditions with respect to the AV+ComplexN condition (red), we can infer that morphological complexity without coercion (blue) is as hard to process as regular nouns with coercion (green).

The RTs in the N-AV+SimpleN condition (purple) are difficult to interpret, due to the mysteriously high RTs at the verb region which carry over to the noun region. It needs to be pointed out, however, that the difference between N-AV+SimpleN condition (purple) and N-AV+ComplexN condition (blue) is not significant, suggesting that in the absence of an AV there is no special cost for morphological complexity (while the cost in the AV+ComplexN condition (red) is evidenced by significantly longer RTs than in the N-AV+ComplexN condition (blue)). Accordingly, we place the N-AV+SimpleN condition in parentheses in (16).

Since the items from Sub-Experiment 2 were intermixed with the items from Sub-Experiment 1 we can conclude that the participants were sensitive to the semantic differences between the entity-denoting and event-denoting complements and the need for coercion in the context of AVs. Therefore, the fact that Sub-Experiment 2 showed the largest processing cost in the coercion condition with morphologically complex nouns seems to indicate that real-time comprehension semantic composition has no access to the morphological structure below the word level. This result is compatible with the predictions of the Enriched Composition approach in (15) where direct compositionality does not allow access to the semantics of the root inside a complex noun (recall that ComplexNs were not nominalizations). The predictions in (15) distinguish between the conditions with type-match and those with type-mismatch, but we found that morphological complexity adds to the cost of type-mismatch.

The result is also compatible with the predictions of the Dimensional Ambiguity approach, because the fact that the AV+SimpleN condition was not the hardest to process as predicted in (13), could be due to the easier resolution of dimension ambiguity in this condition than in the AV+ComplexN condition. As opposed to what we hypothesized, morphological complexity does not facilitate the selection of a dimension appropriate to the semantics of the verb.

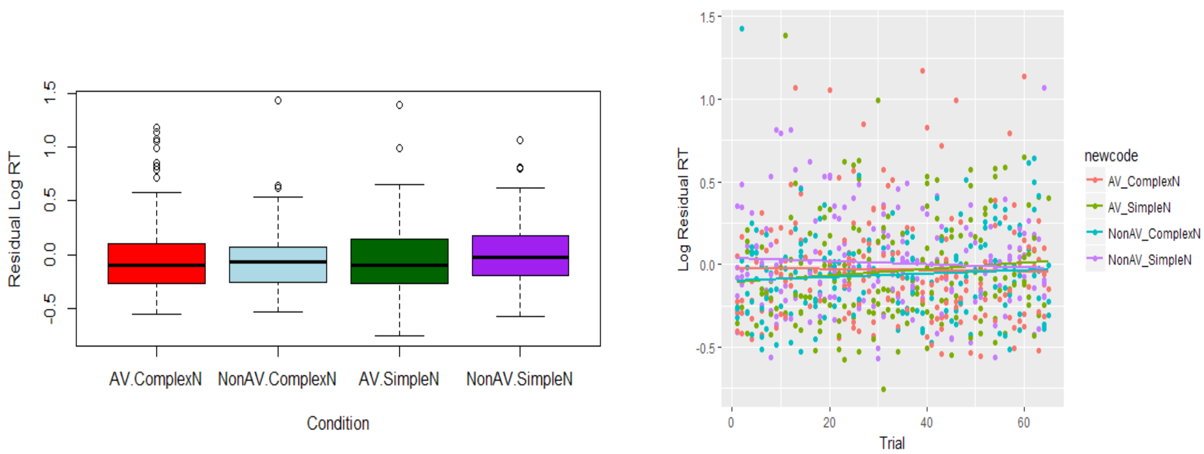
5. General discussion

Our experiment showed that AVs with EventNs (*'begin a fight'*) and N-AVs with EntityNs (*'see a book'*) were easier to process than AVs with EntityNs (*'begin a book'*) and N-AVs with EventNs (*'see a fight'*). This result indicates that processing is easier when the parsing expectations created by the predicate are met. AVs create an expectation for EventNs, which is unsurprising if they specifically select for them. N-AVs, on the other hand, are semantically compatible with both EntityNs and EventNs as their argument, yet EntityNs appear to be preferred over EventNs (at least in Polish). The assumption of the Dimensional Ambiguity hypothesis, that what is at stake for AVs in coercion contexts is the difficulty of identifying the specific dimension along which the complement is construed as a structured individual, cannot account for the fact that the AVs+EventNs and N-AVs+EntityNs are easier to process. However, a theory based on selectional restrictions allows us to explain why these combinations facilitate processing. We should note here that our experimental setup with the increased exposure to coercion contexts (25% of the sentences in the whole experiment) resulted in the absence of a special processing cost for the AV+EntityN condition. Yet, the obtained results clearly show that predicates impose semantic restrictions on their arguments, which supports the Enriched Semantic Composition hypothesis. A theory based on selectional restrictions can also accommodate the result that N-AVs such as *see* combine with both EntityNs and EventNs but are easier to process with the former. This result is in line with the findings in Spalek (2014), who has shown that verbs select for a variety of semantic types of complements, where some of those types are the primary ones while others can be considered secondary but still not anomalous.

Selectional restrictions have been the subject of a longstanding discussion at least since Katz and Fodor (1963) and later Chomsky (1965), who incorporated them as part of grammar in an attempt to express limitations on the applicability of predicates to arguments. Two major questions have been at stage ever since: 1) whether selectional restrictions should be treated as a lexical semantic property or as a matter of world knowledge, and 2) how rich and rigid the inventory of selectional restrictions should be. Our results contribute to this discussion by showing that the idea of incorporating conceptual knowledge into compositional semantics through the notion of selectional restrictions of predicates is fundamentally right, but should be refined by taking into account combinatorial preference patterns. On the basis of our findings we can conclude that AVs differ form N-AVs in that they impose a strong selectional constraint for event nouns, whereas N-AVs have merely a preference for entity-denoting nouns but also combine with event nouns. Our results suggest that a graded notion of selectional satisfaction conditions as mentioned in the work of Wilks (1978) is more appropriate. We propose that the satisfaction conditions of a predicate should be understood as a graded continuum of highly typical arguments and less probable arguments and should thus be called more appropriately 'selectional preferences'. Accordingly, the degree to which various selectional (mis)matches will be judged as semantically anomalous will vary since they do not result from a violation of hard constraints (Resnik, 1996).

Appendix A

Sub-Experiment 2. The Distribution of Log-Transformed Residual Reading Times at the Verb Region summarized in a Boxplot and a Scatterplot over Trials 1-65.



Appendix B

ComplexN – SimpleN pairs in Sub-Experiment 2 and their frequency in everyday use:

zbiór 'set' = *kolekcja* 'collection'
wydruk 'printout' = *odbitka* 'photo print'
przesyłka 'package' = *paczka* 'package'
układanka 'puzzle' = *puzzle* 'puzzle'
opowieść 'story' = *historia* 'story'
budynek 'building' = *dom* 'house'
rysunek 'drawing' = *obrazek* 'drawing, painting'
rzeźba 'sculpture' = *posąg* 'statue'
nasyp 'earth mound' = *sterta* 'heap'
napój 'drink' = *sok* 'juice'
mrożonki 'frozen food' = *lody* 'ice-cream'
wiązanka 'bouquet' = *bukiet* 'bouquet'
przekąska 'snack' = *przystawka* 'appetizer'
naklejka 'sticker' = *ozdoba* 'ornament'
zapałka 'matchstick' =? *świeczka* 'candle'
okop 'trench' < *tunel* 'tunnel'
napar 'infusion' < *herbata* 'tea'
wyszywanka 'embroidery' < *haft* 'embroidery'
czytanka 'school text' < *powieść* 'novel'
malowanka 'picture, colouring' < *ilustracja* 'illustration'
plecionka 'wickerwork, weaved object' < *koszyk* 'basket'
wycinanka 'cutout' < *wzór* 'design'
pismo 'letter, writing' > *list* 'letter'

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Conjoining imperatives and declaratives[1]

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Abstract. This paper investigates conjoined imperatives and declaratives (IaDs). It argues that some IaDs are best explained in terms of true conjunction and anaphora between conjuncts, despite challenges posed by von Fintel and Iatridou (2017). The key to addressing these challenges is a dynamic, non-modal analysis of imperatives building on Starr (to appear). The other IaDs are explained by appeal to a semantically related use of *and*, e.g. 'left-subordinating *and* ($_{LS}$*and*)' (Culicover and Jackendoff 1997). These other IaDs neutralize the directive meaning of the imperative, and this paper offers a new account of this building on 'parameter-change conjunction' (Klinedinst and Rothschild 2012). New data is presented that helps distinguish between the varieties of IaD, and it is shown that the proposed analysis captures it.

Keywords: Conjunction, imperatives, dynamic semantics, anaphora, discourse relations

1. Dividing IaDs and the von Fintel and Iatridou (2017) challenge

Imperative meaning bears on deep theoretical questions about the nature of meaning, especially given standard commitments inherited from the logical tradition that informs contemporary formal semantics. As Frege (1923) comments, and Dummett (1973: Ch.10) later detailed, truly conjoined imperatives and declaratives do not fit with the standard assumptions of formal semantics where all meaning, especially the meaning of connectives, is purely truth-conditional — at least not without assimilating imperatives and declaratives. Dummett (1973: Ch.10) argues that English does not permit such a construction, and that all attempts result in 'non-compositional conditional meanings'. Philosophers now have the benefit of an extensive, sophisticated empirical literature on these constructions.[2] I will draw on the insights of this literature and new data to argue against Frege (1923) and Dummett (1973: Ch.10): natural languages contain truly conjoined imperatives and declaratives, and conditional meanings arise in a principled, compositional manner that is not specific to imperatives. The catch is that one must adopt a dynamic semantics that departs from the assumption that connectives have only truth-conditional meaning.

As a preliminary, it is important to observe that while the compositional issues surrounding classic IaDs like (1) are unresolved, it is a mistake to draw any general conclusion about these issues just from IaDs. As argued by Starr (to appear), conjunctions with the opposite order like (2) establish that imperatives and declaratives compositionally combine via true conjunction.

(1) Make tortillas and I'll serve them.

(2) I love you and don't (you) forget it.

[1]I thank the following for their generous help with this project: Maria Biezma, Ezra Keshet, Kai von Fintel, Sarah Murray and the organizers and audience members at Sinn und Bedeutung 21.

[2]E.g. Bolinger (1979); van der Auwera (1986); Clark (1993); Lascarides and Asher (2003); Txurruka (2003); Franke (2005); Russell (2007); Asher (2007); Franke (2008); Scontras and Gibson (2011); Kaufmann (2012); Keshet (2013); von Fintel and Iatridou (2017), among others.

Examples like (2) are strong evidence against Dummett's (1973: Ch.10) hypothesis — more recently entertained by Franke (2005) and von Fintel and Iatridou (2017) — that *all* conjunctions of imperatives and declaratives involve a special conditional meaning of *and*.[3]

The literature now recognizes three kinds of IaDs, exemplified by (3a)-(5a).[4]

(3) a. Make tortillas and I'll make chile. (endorsed-IaD)

b. $\left\{ \begin{array}{l} \text{\#So} \\ \text{\#But} \end{array} \right\}$ don't make tortillas

(4) a. Screw up the tortillas and I'll rub a chile in your eye. (not endorsed-IaD)

b. $\left\{ \begin{array}{l} \text{So} \\ \text{\#But} \end{array} \right\}$ don't screw up the tortillas.

(5) a. Make tortillas and you'll need flour. (not endorsed-IaD)

b. $\left\{ \begin{array}{l} \text{\#So} \\ \text{But} \end{array} \right\}$ don't make tortillas, it'll make a mess.

(3b)-(5b) are my own contribution to the literature. Previously, examples like (3a) have been described as endorsing the directive conveyed by the imperative conjunct, and so called e-IaDs. Examples like (4a) and (5a) were described as not endorsing the imperative conjunct, and so called n-IaDs. Further, it was noted that examples like (4a) convey a negative evaluation of following the imperative while examples like (5a) present the imperative neutrally. These semi-theoretical descriptions have not been accompanied by a clear empirical diagnostic. While Culicover and Jackendoff (1997) and Kaufmann (2012) observe that *please* can felicitously (and non-sarcastically) occur in examples like (3a) but not in examples like (4a) and (5a), this does little to explain the contrast between (4a) and (5a). I propose that the follow-ups in (3b), (4b) and (5b) can provide just such an empirical diagnostic.

The fact that there is a felicitous way of following up the imperative conjunct with its contrary in (4b) and (5b) shows that the imperative conjunct cannot have directive force. Similarly, the infelicity in (3b) shows that the imperative conjunct does have directive force. Further, the difference between the felicity of *but* and *so* in (4b) and (5b) shows that the non-endorsement of the imperative conjunct is different. The undesirable state of affairs brought about by following the imperative in (4a) invites the inference that the contrary directive should be followed — hence *so* in (4b). The unavailability of *but* follows naturally from this: since the contrary directive (*Don't screw up the tortillas*) follows from what (4a) says in context, its issuance does not contrast with expectations in the way that *but* requires. For (5a), the imperative appears to neutrally introduce the prospect of an action, making it infelicitous to claim with *so* that the contrary imperative follows. It is, however, felicitous to contrast the contrary imperative using *but* since the directive meaning of (5a)'s imperative does not escape the conjunction.

[3] This hypothesis also makes it more awkward to explain the syntactic findings of Scontras and Gibson (2011) which indicate that there are systematic syntactic differences between Type I and Type II IaDs.

[4] See especially Clark (1993), Russell (2007) and von Fintel and Iatridou (2017).

Given these empirical diagnostics and the explanations they suggest, the overall shape of Kaufmann's (2012: Ch.6) divided analysis seems appealing:

Divided Analysis

1. Type I IaDs like (3a) involve true conjunctions that allow the directive meaning to emerge, and the second conjunct's modal is contextually restricted to worlds where the imperative has been followed.
2. Type II IaDs like (4a) and (5a) involve a semantically distinct connective $_{LS}$*and* (Culicover and Jackendoff 1997) which effectively traps the imperative meaning in the antecedent of a conditional.

The appeal of a Divided Analysis is strengthened by a recent study which finds systematic syntactic differences between Type I and Type II IaDs (Scontras and Gibson 2011). The conditional, non-directive meaning of Type II IaDs can be explained in terms of $_{LS}$*and* (Culicover and Jackendoff 1997; Klinedinst and Rothschild 2012), the scope-based analysis of modals and conjunction called *conditional conjunction* (Keshet 2013) or an approach based on a conditional discourse relation being associated with *and* in particular syntactic environments and discourse contexts (Lascarides and Asher 2003). For Type I IaDs, the question is how exactly the modal *will* in the second conjunct is restricted to worlds where the imperative has been followed. Kaufmann (2012: Ch.6) and Lascarides and Asher (2003) treat it as a kind of modal subordination, as in *You should make tortillas and I'll make chile*. Here, the speaker only commits to making chile *if* the addressee makes tortillas. The second modal is interpreted in a way that is subordinated to the first: it is restricted to worlds where the prejacent of the first modal is true. But this appealing approach faces an important problem raised by von Fintel and Iatridou (2017: §3.1): Type I IaDs are felicitous where explicit modal subordination is not. This, of course, throws into doubt the attempt to derive the conditional meaning of Type I IaDs through modal subordination.

Modal subordination is the general phenomenon by which one modal is taken to be restricted to worlds where the prejacent of an earlier modal holds (Roberts 1989). For example, the modal *would* in (6a) is taken to be restricted to worlds where a wolf has wandered in, rendering (6a) and (6b) equivalent.

(6) a. A wolf might wander in. It would eat you.
 b. If a wolf wanders in, it would eat you.

Von Fintel and Iatridou (2017: §3.1) observe that while (7a) is felicitous, an exactly parallel explicit case of modal subordination is not felicitous in (7b).

(7) a. Invest in this company and you will become rich.
 b. #You must invest in this company and you will become rich.

As they note, the infelicity of (7b) could be explained by the general fact that conjunction prohibits the right conjunct from explaining the left (Txurruka 2003):

(8) a. Gabe is not allowed in the tent. He will get it dirty.
b. #Gabe is not allowed in the tent and he will get it dirty.

Von Fintel and Iatridou (2017: §3.1) rightly observe that this only explains why (7b) is infelicitous, not why (7a) is felicitous. Further, von Fintel and Iatridou (2017) challenge a modal subordination analysis to explain the contrast in (9a) and (9c).

(9) a. Don't park there! You'll be towed.
b. = Don't park there! If you park there, you'll be towed.
c. ≠ Don't park there and you'll be towed.

The puzzle is that if modal subordination allows (9a) to be interpreted as (9b), and Type I IaDs like (9c) involve modal subordination, then why doesn't that modal subordination allow the same 'polarity switched' interpretation? Fortunately for the Divided Analysis, I believe these puzzles can be answered. However, it requires abandoning the idea that imperatives are modals, appealing to a more general mechanism of modal anaphora rather than the specific mechanism of modal subordination and investigating the discourse relations that support modal anaphora.

2. Meeting the challenge

Von Fintel and Iatridou (2017: §3.1) give the impression that modal subordination across *and* is always degraded with an explicit deontic modal in the first conjunct.[5] But there is no degradation in conjunctions that don't involve a discourse relation of explanation:

(10) a. Contact your superior and she will explain your next mission.
b. You must contact your superior and she will explain your next mission.

Investigating these good examples, and comparing them to the bad ones yields deeper insight. However, the most important ingredient for understanding these conjunctions is the temporal differences between simple imperatives and modals.

Modals, unlike imperatives, involve *two* eventualities: both of the modality holding — the requirement of contacting your superior — and of the described eventuality — contacting your superior.[6] Crucially, it is the modal eventuality which serves as the argument of higher operators. This is evident with adverbials, which are notoriously sensitive in the same way. The contrast observed by Gärtner (2017) regarding adverbial modifications of imperatives and deontic modals is telling:

(11) a. #Usually, contact your superior.
b. Usually, you must contact your superior.

[5] See von Fintel and Iatridou (2017: fn15) where they grant the existence of naturally occurring examples, but maintain that they are degraded.

[6] To be more precise, modal sentences involve three eventualities and imperatives two, since both also involve the utterance event itself. It is arguably this eventuality that is involved in the interpretation of indexicals like *now* and 'metatalk' discourse relations.

Adverbs like *regularly* that scope low do not exhibit this contrast:

(12) a. Contact your superior regularly.
b. You must contact your superior regularly.

Together, this suggests that imperatives differ fundamentally from necessity modals in that they do not make the necessity itself available as an eventuality to other operators. This insight is directly relevant to IaDs, since discourse relations are fundamentally temporal, and are sensitive to the eventualities topicalized by the conjuncts. In particular, it follows that conjunctions with a modal conjunct will be infelicitous where the corresponding IaDs are felicitous because the discourse relations are relating *different eventualities*. The challenge, then, is to explain why this leads to different behavior in (7) and (10).

Let me first explain why (7a) is felicitous and (7b) is not.[7]

(7) a. Invest in this company and you will become rich.
b. #You must invest in this company and you will become rich.

Von Fintel and Iatridou (2017) are on the right track when the say that (7b) is not felicitous because it attempts to combine an explanation relation with conjunction. But, crucially, that failed explanation interpretation relates *the state of being required to invest* and you becoming rich. No such interpretation is possible for (7a) since the imperative, as detailed above, does not make that state salient. This general limitation is made clear by (13).

(13) ??Invest in this company because you will become rich.

It is perhaps useful to note that (13) is not anomalous because of a general problem with imperatives and *because*:

(14) Donate blood because our reserves are low.

Further, it is often felicitous to explicitly assert an explanation relation for a modal, where it is infelicitous with an imperative.

(15) a. ??Report for duty because your contract requires you to.
b. You must report for duty because your contract requires you to.

All of this evidence suggests that (7a) does not involve an explanation relation, even though (7b) does. (7a) instead involves the relation RESULT.[8] (16a) makes this point clear, while (16b)

[7]Throughout, I will assume familiarity with the basic discourse relations discussed by Kehler (2004), Asher and Lascarides (2003) and Hobbs (1985). While I will follow the general definitions from Kehler and Hobbs, I will assume with Asher and Lascarides (2003) that fully adequate definitions must appeal to eventualities rather than just propositions. Please see these references for further details.

[8]RESULT is typically defined as follows (Kehler 2004: 247): where S_1 and S_2 are the related sentences, infer P from the assertion of S_1 and Q from the assertion of S_2, where normally $P \rightarrow Q$. To generalize to where S_1 is an imperative, appealing to eventualities helps: e_1 is the topical eventuality of S_1 and e_2 of S_2, where normally

shows that such an interpretation with the explicit modal would be anomalous.

(16) a. Invest in this company and, as a result, you will become rich.
b. ??You must invest in this company and, as a result, you will become rich.

The anomaly in (16b) lays bare the situation. Of course (16b) is not felicitous on the same reading as (16a), since that would amount to saying that your riches will result from the state of being (prudentially) required to invest in the company. In short, the contrast von Fintel and Iatridou (2017: §3.1) offer between (7a) and (7b) is manufactured by two different discourse relations, and the complication that imperatives and modals make different eventualities available to those discourse relations. No general point about modal anaphora between conjuncts follows from this though. von Fintel and Iatridou (2017: §3.1) are absolutely right that this anaphoric dependence cannot be assimilated to modal subordination in the strict sense. But this does not preclude a more general *modal anaphora* approach whereby the *will* of the second clause anaphorically retrieves a restriction on its domain from the first clause.

So much for the contrast in (7). What about the lack of any such contrast in (10)? Unlike (7), (10) involves the same discourse relation in the imperative and modal variants, and, somehow, this interpretation works for both variants. (10) clearly involves the relation of OCCASION (Kehler 2004: §3.1.3, Hobbs 1985: 10). Since this relation is a bit more complex, let me explain more precisely what it is. Kehler (2004: 242) offers (17a) as a paradigm example of OCCASION, while (17b) illustrates the limits of OCCASION.[9]

(17) a. George delivered his tax plan to Congress. The Senate scheduled a debate for next week.
b. ?George delivered his tax plan to Congress. The Senate scheduled hearings into former President Clinton's pardon of Marc Rich.

The crucial feature in (17a) is that elements of a complex situation through an intermediate state of affairs that serves to connect two parts of that complex situation: the state where the tax plan has been delivered to the Senate connects that delivery, and the scheduling of the debate. Unlike RESULT this relation can be much more complex and nuanced that cause/effect or defeasible entailment. For example, the tax plan could only be a very small and minor component of the debate, but procedurally required for scheduling the debate. This highlights how domain knowledge, such as protocol, can inform the inference of OCCASION. (17b) makes clear that this is a substantive constraint. When there is no perceived script (prototypical chain of events) connecting the two events, this discourse is not coherent.

Causes(e_1, e_2) — *Causes* is a non-monotonic conditional-like operator (Asher and Lascarides 2003).

[9] OCCASION between S_1 and S_2 is typically defined as: (i) a change of state can be inferred from the assertion of S_1, whose final state can be inferred from S_2; or (ii) a change of state can be inferred from the assertion of S_2, whose initial state can be inferred from S_1 (Hobbs 1985: 10). Here, the terms of 'final' and initial should be understood in terms of prototypical sequences of events, given relevant domain knowledge. I will generalize this by understanding OCCASION as follows: (i) e_1 is the topical eventuality of S_1, e_2 is the topical eventuality of S_2 and e_1 results in a change of state whose final state results from e_2; or (ii) e_1 is the topical eventuality of S_1, e_2 is the topical eventuality of S_2 and e_2 results in a change of state whose initial state results from e_1.

Returning now to imperatives, Hobbs (1985: 10) actually offers the imperatives in (18) as a paradigm illustration of OCCASION at work:

(18) a. Walk out the door of this building.
b. Turn left.
c. Go to the corner.

A complex situation, namely the sequence of actions needed to get the addressee to a specific location, is explained through a series of intermediate states of affairs that connect the events described by each sentence. The imperative (18a) introduces a change of location whose result holds during the event described in the next imperative (18b), and similarly for (18b) and (18c). This helps clarify that OCCASION is often at work with imperatives, and the fact that *and* could be placed between these sentences makes clear that conjunction is compatible with *and*. It also further clarifies that OCCASION is very different from RESULT in that it needn't involve a cause/effect relationship. With all this in mind, let us consider why OCCASION supports both variants in (10).

(10) a. Contact your superior and she will explain your next mission.
b. You must contact your superior and she will explain your next mission.

The operation of OCCASION in (10a) is clear enough. The causal result of contacting your superior produces a state that leads to the goal of the discourse: an informed agent. But, how does OCCASION work in (10b), given that the first conjunct topicalizes the state of being required to contact your superior, rather than the event of you contacting them? The prototypical result of that requirement is fulfillment, which connects the conjuncts as before. The reliance on prototypical sequences of events allows OCCASION this inferential flexibility.

As Kehler (2004) and Hobbs (1985) highlight, OCCASION is highly sensitive to surprising nuances of human cognition and discourse goals. From the infelicity of (7b), we can infer that there is no relevant prototypical sequence of events connecting a prudential requirement to invest and becoming rich that satisfies the agents' domain goals. On reflection, that is an independently plausible description of the natural context for (7). The discourse goal, presumably, is for the speaker to convince an undecided hearer to invest. This means that there is no shared 'final state' which OCCASION can target with a prototypical chain of events. On reflection, it is clear that (10) involves a case where speaker and hearer have a shared 'final state', allowing the speaker to invoke a prototypical chain of events culminating in that final state. While these nuanced differences are easy to miss when studying isolated examples, they are precisely the details that form the natural habitat of human discourse.

One more piece of data from von Fintel and Iatridou (2017: §3.1) needs to be addressed: the polarity switch contrast in (9a) and (9c).

(9) a. Don't park there! You'll be towed.
b. = Don't park there! If you park there, you'll be towed.
c. ≠ Don't park there and you'll be towed.

It has been established thus far that modal anaphora between conjuncts is very much a live explanation of Type I IaDs. From this perspective, (9a) involves complement anaphora. But then (9c) is exactly what one expects, given that complement anaphora is known to be incompatible with conjunction (Nouwen 2003).

(19) a. Few congressmen admire Kennedy. They think he's incompetent.
b. #Few congressmen admire Kennedy and they think he's incompetent.

This means that a fully general theory of modal anaphora can appeal to the same mechanisms at work in (19) to explain (9), all while sticking with an explanation of Type I IaDs on which the second conjunct anaphorically retrieves a proposition made salient by the first conjunct. I now turn to that analysis.

3. Preference semantics with modal anaphora

This section will adapt the dynamic preference semantics from Starr (to appear) to offer analyses of Type I and Type II IaDs. After introducing this basic analysis of imperatives and connectives in §3.1, I will turn to Type I IaDs in §3.2 and Type II IaDs in §3.3. There are three key innovations in these sections. The first is to model the process by which modal anaphora generates a conditional meaning in Type I IaDs. The second is to model the meaning of $_{LS}$*and* in a way that neutralizes the directive meaning of the first conjunct. The third is capturing the fact that negative Type II IaDs seem to entail the prohibition of the first conjunct. In particular, it will be shown that this can be captured as a simple contextual entailment on a dynamic preference semantics. Together, these innovations explain the basic data of (3)-(5) from §1. Throughout this section, my presentation of the semantics will aim only to convey the basic ideas and innovations. Full formal definitions are reserved for Appendix 4.

3.1. Preference semantics for imperatives

The data discussed so far places non-trivial restrictions on the kind of imperative semantics that can be used to explain IaDs. The data discussed in §2 are problematic for modal analyses like Kaufmann (2012) and Aloni (2007). This problem is avoided by static non-propositional analyses like Portner (2004) and Roberts (2015) which assign imperatives and declaratives to distinct semantic types and to distinct pragmatic context update rules. As Starr (to appear) argues in detail, those two commitments make it impossible to adequately capture conjunctions like (2) and other related examples. Starr (to appear) addresses this limitation by adopting a dynamic preference semantics for imperatives. A dynamic semantics also makes capturing the anaphoric dynamics within a conjunction far easier. The basic idea of this dynamic semantics for imperatives is simple: !A introduces a preference for A-worlds over ¬A-worlds.[10] This basic idea can be represented graphically as in Figure 1. Here, worlds are dots with a capital letter indicating truth and lowercase falsity and preferences are indicated with complimentary pairs

[10]While Portner (2004) has the primary pragmatic effect of imperatives to be the update of a To-do List, a secondary effect is that the To-do List is used to generate an ordering of worlds from the context set. By contrast, the account here has the primary semantic meaning of imperatives be an update on an ordering. Having an ordering over sets of worlds affords a useful resource for conditional imperatives (Starr to appear).

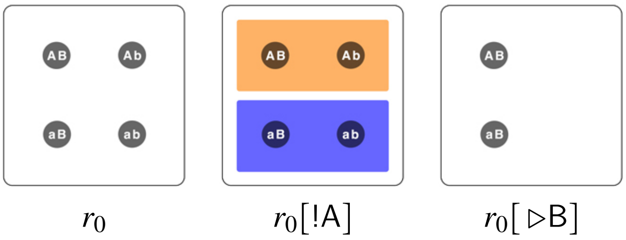


Figure 1: Imperative and Declarative Updates

of colors. The warm color of the pair is used for the preferred alternative. This makes clear that the meaning of imperatives is dynamic: its meaning is specified in terms of how it changes a preference relation r. It also clarifies how imperatives and declaratives differ. A declarative $\triangleright\mathsf{B}$ would eliminate $\neg\mathsf{B}$-worlds entirely.

Formally, a preference relation is a set of pairs of propositions: $r = \{\langle p_1, p_2\rangle, \ldots, \langle p_n, p_m\rangle\}$. The context set is reconstructed by unioning all of the ranked alternatives: $c_r = \bigcup(\operatorname{dom} r \cup \operatorname{ran} r)$. r_0 simply ranks all the worlds over the empty set: $r_0 = \{\langle\{w_{\mathsf{AB}}, w_{\mathsf{Ab}}, w_{\mathsf{aB}}, w_{\mathsf{ab}}\}, \varnothing\rangle\}$. So $!\mathsf{A}$ changes r to $\{\langle p_1, p_2\rangle, \ldots, \langle p_n, p_m\rangle, \langle c_r \cap [\![\mathsf{A}]\!], c_r - [\![\mathsf{A}]\!]\rangle\}$, while the declarative $\triangleright\mathsf{A}$ will eliminate $\neg\mathsf{A}$-worlds from each proposition ranked in r. On this approach, $[\phi]$ is the meaning of ϕ, applying to r to yield r': $r[\phi] = r'$.[11] To analyze disjunction, Starr (to appear) lifts the type of states to *sets of preference relations*, and calls them *preference states*. Since disjunction is not at issue here, I will present the system in the simpler form here.

In this framework, conjunction can be analyzed in the standard dynamic way, sequential update: $r[\phi \wedge \psi] = (r[\phi])[\psi]$. Unlike a static analysis like Portner (2004), this allows imperatives and declaratives to fluidly combine. It offers an immediate account of examples like (2) which would have the general form of $\triangleright\mathsf{B} \wedge !\mathsf{A}$. The result is depicted in Figure 2. This result plausibly

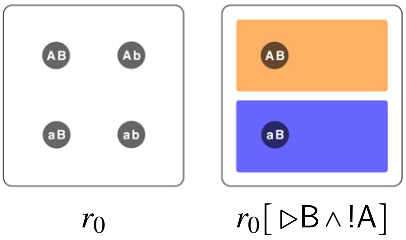


Figure 2: Update with a DaI (Declarative-and-Imperative)

gives the meaning of mixed conjunctions like (2), but not for Type I IaDs. Applying this analysis to (3a) does not capture the fact that it only commits the speaker to making chile in worlds where the addressee makes tortillas.

(3) a. Make tortillas and I'll make chile.

[11] While I borrow the notation from Veltman (1996), this is not an update semantics in the technical sense defined by Veltman (1996): it is not generally true that $r \subseteq r[!\mathsf{A}]$.

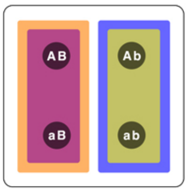
To capture this feature of (3a), one has to model the anaphoric relationship between the conjuncts. Further, since discourse relations mediate this anaphora and feature into the interpretation of conjunction itself, a more complex interpretation of *and* is needed. This will be addressed in §3.2. For now, I will turn to introducing some further details about this general approach to imperatives that will be used below.

In order to explain (3)-(5) from §1, it is necessary to define notions of support and consistency for imperatives. Developing these concepts in an adequate way is rather difficult for a non-propositional analysis. Static analyses like Portner (2004) do not provide adequate definitions of these concepts, but a dynamic preference semantics provides useful resources here (Starr to appear). Like other dynamic accounts (e.g. van Rooij 2000; van Benthem and Liu 2007; Portner 2012), I will model the logic of imperatives in terms of how they update an ordering of alternatives. Dynamic accounts of *informational support* ($\vDash$) hold that c informationally supports ϕ just in case updating c with ϕ doesn't change c (e.g. Veltman 1996). This idea can be applied here by focusing on *preferential support*:

Preferential Support $r \Vdash \phi \iff r[\phi] = r$.

This notion of support will be relied upon to explain the felicity (or lack thereof) for the *so* follow ups in (3b)-(5b). The basic idea is that $\mathsf{So}(!\mathsf{A})$ is felicitous just in case $!\mathsf{A}$ is preferentially supported by the preference relation that results from updating with prior discourse.

Preferential consistency is understood with an eye to the practical function of preferences: they are to motivate choices. Accordingly, inconsistent preferences are those that would not facilitate choosing an alternative. This is particularly clear when considering contrary imperatives, and the preferences they lead to, as depicted in Figure 3. The resulting preference relation



$r_0[!\mathsf{B}][!\neg\mathsf{B}]$

Figure 3: Contrary Imperatives Lead to Cyclic Preferences

$r_0[!\mathsf{B}][!\neg\mathsf{B}]$ is irrational because it has a cyclic subset $\{\langle b,\overline{b}\rangle,\langle\overline{b},b\rangle\}$. These preferences are irrational in a practical way: it would be defective for motivating choices because every alternative is worse than another. Starr (to appear) details the conditions preferences must have to be rational in this sense. For our purposes here, acyclicity is all that will matter. Preferential inconsistency simply requires that the sentences never lead to a rational preference relation:

Preferential Inconsistency
ϕ and ψ are preferentially inconsistent just in case there is no r such that $r[\phi][\psi]$ is rational. (See Starr to appear for the relevant definition of *rational*.)

This will be used to explain the infelicity of *but* follow-ups in (3b)-(5b). The basic idea is that $\mathsf{But}(\phi)$ is not felicitous when ϕ is preferentially or informationally inconsistent with the prior sentences in the discourse.

3.2. Type I IaDs

There are a number of feasible ways to capture the anaphoric conditional meaning of *will* in the second conjunct. The analysis proposed here makes three key assumptions.

Essential Features of Analysis

1. $!\mathsf{A}$ introduces an eventuality or proposition — the event or proposition that A — that subsequent operators can anaphorically retrieve (Hobbs 1985; Lascarides and Asher 2003 and Murray and Starr to appear).
2. *Will* can anaphorically retrieve the eventuality or proposition introduced by $!\mathsf{A}$ to treat as its domain of universal quantification (Frank and Kamp 1997; Stone 1999; Stojnić 2016).
3. The anaphoric interpretation of *will* is mediated by inferred discourse relations (Hobbs 1985; Lascarides and Asher 2003; Stojnić 2016).

Since *will* has a partly temporal semantics, and discourse relations primarily relate eventualities, no analysis of IaDs will be complete without attending to temporal issues. However, doing so also introduces a number of complexities that are peripheral to the main project here. Accordingly, I will offer a purely modal analysis of *will* caste in a stack-based update semantics similar to Kaufmann (2000). This implementation choice introduces three inessential assumptions that are worth highlighting at the outset.

Inessential Implementation Features

1. Modals like *will* are tests (Veltman 1996).
2. *Will* expresses simple epistemic necessity with respect to c_r (Kaufmann 2000).
3. By default, *will* is anaphoric to the previously introduced modal topic.

It would be perfectly feasible to recast the basic analysis presented here within Kratzer's (1981) approach to modality, integrating temporality in any of a number of ways (Portner 2009: Ch.5). Or, one could treat *will* as having a purely temporal semantics and make use of the eventuality introduced by imperatives. Any analysis within these broad families could be made to fit with the general proposal that follows. On the third inessential feature, it is important to clarify that this is not presumed to be an empirically justified default, but rather an attempt to abstract from the complex details of anaphora resolution and discourse structure.[12] While this limits the empirical testability of the theory as stated, this is just as it should be. I am not attempting to predict particular anaphoric patterns here, but just show how to characterize the anaphoric interpretations when they do arise.

As highlighted above, I will treat $\mathsf{Will}(\mathsf{A})$ as a test that all of the worlds drawn from some

[12]For one plausible account of these complexities see Stojnić (2016).

contextually salient information source are worlds where A is true. If this test is passed, then the input r is returned; otherwise the empty relation results. On this approach, $!\mathsf{A} \wedge \mathsf{Will}(\mathsf{B})$ should first introduce a preference for A-worlds and then test that all of these A-worlds are B-worlds. As Figure 4 shows, a preference relation like r_0 fails this test but one like r_1 passes it. As the diagram for $r_1[!\mathsf{A} \wedge \mathsf{Will}(\mathsf{B})]$ makes clear, B only has to hold among the live A-worlds.

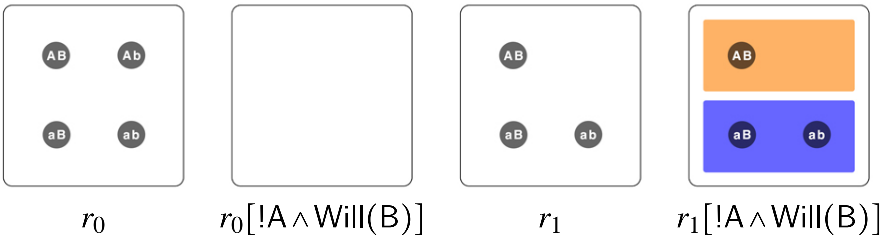


Figure 4: Type I IaDs

While this specifies the target interpretation, I have not said how it is compositionally produced. This is achieved by defining updates over *states*.

A state $s = \langle r_s, d_s \rangle$ pairs a preference relation r_s with a tuple of modal discourse topics $d_s = \langle p_i, \ldots, p_j, c_{r_s} \rangle$, which are just sets of worlds. The context set c_{r_s} is always a possible modal discourse topic, so d_s will always contain c_{r_s} — I reserve the last slot of d_s for c_{r_s}. Now, in addition to introducing a preference for A-worlds, $!\mathsf{A}$ will also append those A-worlds to the front of d_s. $\mathsf{Will}(\mathsf{B})$ can then anaphorically retrieve its domain from $d_{s[!\mathsf{A}]}$: it tests that B holds throughout the first modal topic in $d_{s[!\mathsf{A}]}$. This is laid out in Figure 5, which illustrates how $\mathsf{Will}(\mathsf{B})$ gains access to the A-worlds. This basic approach to the semantics also provides a

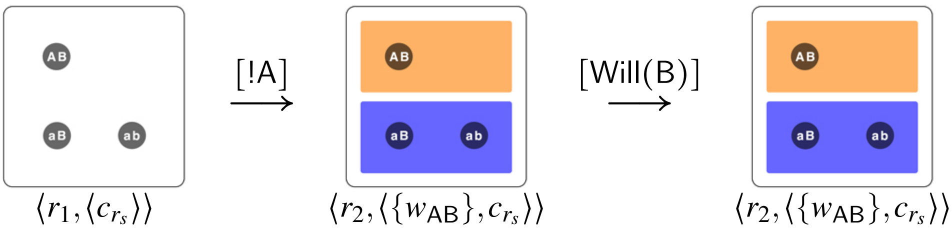


Figure 5: Anaphoric Interpretation of $!\mathsf{A} \wedge \mathsf{Will}(\mathsf{B})$

way of capturing the anaphoric interpretation of imperatives themselves, as in (18). Of course, to make this a comprehensive analysis for any of the data presented here, one needs an actual theory of anaphora resolution rather than assuming that *will* is always anaphoric when it follows an imperative across *and* or a discourse segment. For conjunctions, this would involve specifying $s[!\mathsf{A}][DR_\wedge][\mathsf{Will}(\mathsf{B})]$, where $DR_\wedge$ is a non-montonically inferred discourse relation lexically compatible with *and* which specifies whether or not $\mathsf{Will}(\mathsf{B})$ gets interpreted in a state where the A-worlds are the first discourse topic. Non-anaphoric discourse relations could detopicalize those A-worlds. The same style of analysis would work across discourse segments, where the lexical constraints on discourse relations are lifted.

Here's why (3b) is infelicitous. $\mathsf{So}!\neg\mathsf{A}$ is infelicitous after $!\mathsf{A} \wedge \mathsf{Will}(\mathsf{B})$ because $!\neg\mathsf{A}$ is not preferentially supported by $!\mathsf{A} \wedge \mathsf{Will}(\mathsf{B})$ in this context. $!\neg\mathsf{A}$ will add a preference for $\neg\mathsf{A}$-worlds that $!\mathsf{A} \wedge \mathsf{Will}(\mathsf{B})$ does not require to be present. $\mathsf{But}!\neg\mathsf{A}$ is infelicitous after $!\mathsf{A} \wedge \mathsf{Will}(\mathsf{B})$

because it requires at a minimum that $!\mathsf{A} \wedge \mathsf{Will}(\mathsf{B})$ and $!\neg\mathsf{A}$ are preferentially consistent. But that leads to preferences like Figure 3 — the paradigm case of a preferential inconsistency.

3.3. Type II IaDs

The central challenge for Type II IaDs is to explain both how the conditional interpretation arises, and how the directive meaning of the imperative conjunct is neutralized. As Culicover and Jackendoff (1997) observe, these features also arise with some declarative conjuncts:

(20) a. You drink another can of beer and I'm leaving.
b. Big Louie sees you with the loot and he puts out a contract on you.

Neither variant involves asserting the first conjunct, just as neither (4a) nor (5a) involve directives. Culicover and Jackendoff (1997) propose that there is a semantic ambiguity between the familiar meaning of *and* and the *left-subordinating and* ($_{LS}$*and*) in (20). This general approach to Type II IaDs has been pursued by Russell (2007), Kaufmann (2012), Klinedinst and Rothschild (2012), among others. It also coheres nicely with an experimental study of IaDs (Scontras and Gibson 2011). This study compared quantitative acceptability ratings of emphatic *do* and explicit subjects in Type I and Type II IaDs across a large sample of naive speakers. They found that these elements very significantly decreased the acceptability of Type II IaDs, but not Type I IaDs. I will pursue a variant of this ambiguity analysis below, showing how it is possible to relate the two meanings of *and* and allow imperatives to have their normal directive semantics without having their normal directive effect on context. But a brief word about alternative analyses is in order.

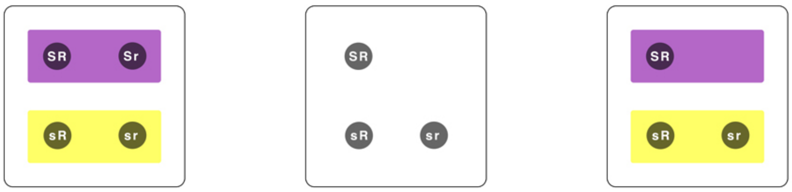
Keshet (2013) and Keshet and Medeiros (2017) argue that the Type I/Type II distinction is a fundamentally syntactic, scopal one. Imperatives are taken to be modal operators, and it is maintained that Type II IaDs involve that modal scoping over the entire conjunction with the first conjunct serving as the restrictor and the second as the nuclear scope. On this approach, Type II IaDs are not really conjoined imperatives and declaratives, but rather a complex type of modal sentence. (Though Type I IaDs are true conjunctions of imperatives and declaratives.) This approach has the merit of not postulating an ambiguity in *and*, and does not require any account of how the first imperative's directive fore is neutralized. The latter achievement is particularly attractive since some existing accounts of the neutralization like Han (1998) and Russell (2007) are problematic. I will not follow this syntactic approach since I think it is problematic to treat imperatives as modal operators for the reasons discussed in §2 and Starr (to appear). However, I take seriously the merits of this approach and speak to them below.

Similar to the 'parameter shifting *and*' defined in Klinedinst and Rothschild (2012), I propose that the first conjunct of $_{LS}$*and* only has its effect on d_s.

Semantics of $_{LS}$*and* $s[\phi\, _{LS}\!\wedge \psi] = (\langle s, d_{s[\phi]}\rangle)[\psi]$

This does not attribute completely unrelated meanings to $_{LS}\wedge$ and $\wedge$: while $\wedge$ sequentially updates both components of states, ${}_{LS}\wedge$ only updates one of them. Klinedinst and Rothschild (2012) argue that this a general feature of connectives that a multidimensional dynamic framework is well-suited to capture. This variant of conjunction neutralizes the first conjunct's effect on r_s and allows the conditional interpretation to be derived anaphorically just as with Type I IaDs, i.e. by inferring appropriate discourse relations between the conjuncts. Just as with *and*, there must be substantial constraints on which discourse relations are compatible with ${}_{LS}$*and* — indeed it is clear that it must require subordinating discourse relations like Explanation, Instance, Background, Elaboration, Generalization, etc. Presumably something like this restriction would be needed to explain why not all combinations of tense/aspect work in purely declarative ${}_{LS}$*and* constructions, and why emphatic *do* degrades Type II IaDs. Unfortunately, this component of the analysis is beyond the scope of this paper.

On this approach, (5a) amounts to $!\mathsf{M}_{LS}\wedge\mathsf{Will}(\mathsf{F})$. Crucially, $!\mathsf{M}$ only contributes its modal discourse topic to the state in which the second conjunct is evaluated. As with Type I IaDs, the conditional reading is generated when *will* is anaphoric to this topic. (As discussed above, the conditional readings of (20a) and (20b) would have to be derived from inferred subordinating discourse relations.) This not only explains the conditional interpretation, and the lack of directive meaning. It explains why $\mathsf{So}\,!\neg\mathsf{M}$ is an infelicitous follow-up while $\mathsf{But}\,!\neg\mathsf{M}$ is felicitous. Updating $!\mathsf{M}_{LS}\wedge\mathsf{Will}(\mathsf{F})$ has no effect directly on the preferences, so it cannot guarantee that the preferences added by $!\neg\mathsf{M}$ will already be present in the state. Thus $\mathsf{So}\,!\neg\mathsf{M}$ is infelicitous. However, for the same reason, $!\mathsf{M}_{LS}\wedge\mathsf{Will}(\mathsf{F})$ and $!\neg\mathsf{M}$ are preferentially consistent. Further, there is no tension between this context an the contrastive content of *but*, so $\mathsf{But}\,!\neg\mathsf{M}$ is felicitous. I now turn to Type II IaDs like (4a).



Contextual Preference r_2 $\quad s_0[!\mathsf{S}_{LS}\wedge\mathsf{Will}(\mathsf{R})]$ $\quad \langle r_2,\langle c_{r_2}\rangle\rangle[!\mathsf{S}_{LS}\wedge\mathsf{Will}(\mathsf{R})]$

Figure 6: Negative Preferences and Type II IaDs

Explaining the pattern in (4b) requires examining more closely the context in which (4a) occurs. Both speaker and hearer can take it for granted that worlds where the speaker doesn't rub chile in the hearer's eye ($\neg\mathsf{R}$) are preferable to ones where they do (R). This background context is depicted as r_2 in Figure 6. The Type II IaD (4b) *Screw up the tortillas and I'll rub chile in your eye* is represented as $!\mathsf{S}_{LS}\wedge\mathsf{Will}(\mathsf{R})$ and, in general, rules out the world w_{Sr}, depicted in Figure 6. So in its natural context, $!\mathsf{S}_{LS}\wedge\mathsf{Will}(\mathsf{R})$ will lead to the third preference relation depicted in Figure 6. This explains why $\mathsf{So}\,!\neg\mathsf{S}$ is a felicitous follow-up while $\mathsf{But}\,!\neg\mathsf{S}$ is not. $\langle r_2,\langle c_{r_2}\rangle\rangle[!\mathsf{S}_{LS}\wedge\mathsf{Will}(\mathsf{R})]$ is a state that preferentially supports $!\neg\mathsf{S}$: the imperative would impose a preference already in place. For this reason, the contrastive or contrary-to-expectations content of *but* rules out $\mathsf{But}\,!\neg\mathsf{S}$ as a follow up, though it is preferentially consistent.

4. Conclusion

This paper has proposed an analysis of IaDs that captures their conditional meaning as modal anaphora and explains the contrasts between types of IaDs exhibited in (3)-(5). I argued that this modal anaphora approach can be made to meet the challenges posed by von Fintel and Iatridou (2017) if it draws a sharp distinction between modals and imperatives. The dynamic, non-modal analysis has much in common with Lascarides and Asher (2003), in particular its reliance on inferred discourse relations. But, instead of founding the Type I/Type II distinction purely in the inferred discourse relation, I followed Klinedinst and Rothschild (2012) in taking this distinction to involve two semantically overlapping connectives. This made it possible to neutralize the directive meaning of the first conjunct without the problematic assumptions made by Han (1998) and Russell (2007).[13] By relating imperatives to preferences instead of actions as Lascarides and Asher (2003) do, it was possible to explain the interaction of contextual preferences with the interpretation of negative IaDs. Future work is needed to spell out the resolution of discourse relations in this analysis and to extend it to conditional readings of disjunctions (e.g. Franke 2005 and Biezma and Rawlins 2016).

Appendix A. Dynamic Logic of Mood with Modal Anaphora

Definition 1 (DLMA Syntax)

(1)	$\alpha \in \mathcal{R}ad$	if $\alpha \in At = \{\mathsf{A},\mathsf{B},\mathsf{C},\mathsf{D},\ldots\}$
(2)	$\neg\rho \in \mathcal{R}ad$	if $\rho \in \mathcal{R}ad$
(3)	$(\rho_1 \wedge \rho_2) \in \mathcal{R}ad$	if $\rho_1, \rho_2 \in \mathcal{R}ad$
(4)	$\mathsf{Will}(\rho) \in \mathcal{S}ent$	if $\rho \in \mathcal{R}ad$
(5)	$\triangleright\rho \in \mathcal{S}ent$	if $\rho \in \mathcal{R}ad$
(6)	$!\rho \in \mathcal{S}ent$	if $\rho \in \mathcal{R}ad$
(7)	$(\phi \wedge \psi) \in \mathcal{S}ent$	if $\phi, \psi \in \mathcal{S}ent$
(8)	$\neg\phi \in \mathcal{S}ent$	if $\phi = \mathsf{Will}(\rho)$ & $\rho \in \mathcal{R}ad$

Definition 2 (Preference Relations)

1. A **preference relation** r is a relation on propositions
   - W is the set of possible worlds; each assigns every atomic radical to one truth-value
     - $W : At \mapsto \{0,1\}$
   - $r : \wp(W) \times \wp(W)$
2. r's **context set** c_r is the union of propositions ranked by r.
   - $c_r = \text{field}\, r$, where $\text{field}\, r = \text{dom}\, r \cup \text{ran}\, r$

Definition 3 (States) A *state* $s = \langle r_s, d_s \rangle$ is a pair consisting of a preference relation r_s and an n-tuple of propositions $d_s = \langle p_i, \ldots, p_j, c_{r_s} \rangle \in \wp(W)^n$, where $n \geqslant 1$.

- d_s is the list of modal discourse topics.
- d_s always contains c_{r_s} as its last element; c_{r_s} is always a discourse topic.
- When $n = 1$, $d_s = \langle c_{r_s} \rangle$.

[13] Han (1998) employs a controversial feature deletion, while Russell (2007) incorrectly assumes that Type II IaDs involve an infinitive rather than an imperative (von Fintel and Iatridou 2017: §3.4).

Definition 4 (Initial State) $\mathbf{I} := \langle\{\langle W, \varnothing\rangle\}, \langle W\rangle\rangle$

Definition 5 (Atomic Radical Semantics) For $c \subseteq W$, $\alpha \in At$: $c[\alpha] = \{w \in c \mid w(\alpha) = 1\}$

Definition 6 (Imperative Semantics)
$s[!\rho] = \langle r_s \cup \{\langle c_{r_s}[\rho], c_{r_s} - c_{r_s}[\rho]\rangle\}, c_{r_s}[\rho] \circ d_s\rangle$

- $q \circ d_s := \langle q, p_n, \ldots, p_1\rangle \in \wp(W)^{n+1}$ where $q \subseteq W$, $d_s = \langle p_n, \ldots p_1\rangle \in \wp(W)^n$ and $n \geqslant 1$.

Definition 7 (Declarative Semantics)
$s[\rhd\rho] = \langle r_s + \rho, c_{r_s}[\rho] \bullet d_s\rangle$, where $r_s + \rho = \{\langle a[\rho], a'[\rho]\rangle \mid \langle a, a'\rangle \in r_s \;\&\; a[\rho] \neq \varnothing\}$.

- $q \bullet d_s := \langle q, p_n, \ldots, q \cap p_1\rangle \in \wp(W)^{n+1}$ where $q \subseteq W$, $d_s = \langle p_n, \ldots p_1\rangle \in \wp(W)^n$ and $n \geqslant 1$.

Definition 8 (Will Semantics)
$s[\mathsf{Will}(\rho)] = \langle\{\langle a, a'\rangle \in r_s \mid 1(d_s)[\rho] = c_{r_s}\}, d_s\rangle$, where $1(d_s)$ is the first element of d_s.

Remark 1 Definition 8 does not have *will* introduce any modal topics, but that is only for simplicity. At the very least, it should probably introduce $1(d_s)[\rho]$ as a modal topic — but exploring the relevant data here is not possible.

Definition 9 (Connective Semantics) $\rho, \rho_1, \rho_2 \in \mathcal{R}ad$; $\phi, \psi, \neg\phi \in Sent$

1. $c[\rho_1 \wedge \rho_2] = (c[\rho_1])[\rho_2]$
2. $c[\neg\rho] = c - c[\rho]$
3. $s[\phi \wedge \psi] = (s[\phi])[\psi]$
4. $s[\neg\phi] = s \ominus s[\phi]$

- $s \ominus s' := \langle\{\langle a_1, a_2\rangle \mid a_1 = a_3 - c_{s'} \;\&\; a_2 = a_4 - c_{s'} \;\&\; \langle a_3, a_4\rangle \in r_s\}, d_s\rangle$
  - $s \ominus s'$ removes any modal topics in s' and not in s, and removes worlds from every alternative in r_s that are in $c_{r_{s'}}$.

Definition 10 ($_{LS}$*and* Semantics)
$s[\phi\,{}_{LS}\!\wedge\psi] = (\langle s, d_{s[\phi]}\rangle)[\psi]$

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Let's talk about the future: An investigation of temporal reference in Kaqchikel[1]

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Abstract. This paper provides an analysis of temporal reference in the understudied language, Kaqchikel (Mayan). Building on results from recent studies of temporal reference in languages that lack overt grammatical tense by Matthewson (2006) for St'át'imcets and Tonhauser (2011) for Guaraní as well as the distantly related language Yucatec Maya by Bohnemeyer (1998), I consider both a tensed and tenseless analysis for Kaqchikel. Testing first for whether or not the obligatory aspect/mood markers on finite verbs contribute temporal reference and then testing for the possibility of covert tense, I show that Kaqchikel lacks the non-future temporal restriction present in St'át'imcets and Guaraní. Instead, I argue that Kaqchikel behaves more like Hausa as discussed in Mucha (2013), and ultimately I conclude that Kaqchikel is a tenseless language where temporal reference is determined by context and temporal adverbials.

Keywords: Tense and aspect, tenseless languages, Mayan linguistics.

1. Introduction

The observation that languages vary with respect to how temporal relationships are encoded is not a novel one. Out of this observation has sprung a lively debate about the status of tense in languages that appear to be tenseless, where tense is minimally not an overt morphological marking. One of the central questions in the discussion is whether or not there are truly tenseless languages, where tense is not a grammatical category. For languages to be truly tenseless, the reference time of an utterance is established using other means, such as discourse context and temporal adverbials rather than a grammaticized tense morpheme. However, languages like St'át'imcets (Lillooet Salish), which are at least tenseless on the surface, are observed to have a restriction on future reference times. Matthewson (2006) provides an account of St'át'imcets as a language that is only superficially tenseless with a phonologically empty non-future tense morpheme, TENSE, restricting reference times to non-future time intervals with respect to utterance time. Another language with a similar pattern with a non-future restriction for finite clauses is Paraguayan Guaraní (Tupí Guaraní). Tonhauser (2011) tests both a tensed and tenseless analysis of Guaraní, and ultimately concludes that a tenseless approach for Guaraní is the simpler and thus preferable analysis based on evidence from subordinate clauses and other more complex sentence types.

While both Guaraní and St'át'imcets finite verbs discussed in the two aforementioned studies are unmarked for aspect or mood, the focus of this paper is Kaqchikel (Mayan), a language in which finite verbs are obligatorily marked for aspect or mood. Because all finite clauses are marked for with one of four (tense)-aspect-mood ((T)AM) markers, it shifts the direction of the present study to first considering whether or not any of the (T)AM markers are encoding tem-

[1]I would like to thank the Kaqchikel speakers in Sololá, Guatemala that I have had the opportunity to work with, namely Rigoberto Choy and Lucia Choy. Without their endless patience and willingness to help, none of this work would be possible.

poral reference, and if not, then asking the question as to what, if any, restrictions on temporal reference there are. Ultimately, I conclude that Kaqchikel is best analyzed as a truly tenseless language, which exhibits no restrictions on future reference times, namely for verbs marked with the imperfective aspect.

Following the ideas first formalized in Reichenbach (1947) and further developed by Klein (1994) among others, I assume that temporal relationships in natural language involve three times: the time at which utterance is made (utterance time), the time interval the eventuality is constrained (reference time), and the time that the eventuality takes place (event time). Further, I assume that tense is the relationship between the reference time (RT) and utterance time (UT) and that aspect relates reference time (RT) to event time (ET). Languages that are said to be tensed languages, such as English, encode the relationship between UT and RT grammatically with tense morphology, which is illustrated in (1). In (1a), the verb *play* is marked with the morpheme *-ed*, which encodes the past tense in that the RT is prior to UT (RT < UT) In (1b), the auxiliary verb *be* is inflected for the present tense, and the RT is the same as UT (i.e. RT=UT)

(1) a. I played basketball.
    b. I am playing basketball.

Grammatical tense in English serves to establish the RT with respect to UT, but the RT time interval can be further constrained either in context or using temporal adverbials (e.g. *tomorrow, yesterday, at 8 o'clock tonight*) to a more specific time interval within the past/present/future RT. In (2a) the RT is constrained to a past RT and further to a time interval coinciding with the day prior to UT, which is established by use of *yesterday* in Speaker A's question. In (2b), the time interval introduced by *last week* constrains the basketball playing event to the time interval that coincides with the week prior to UT.

(2) a. A. What did you do yesterday?
       B. I played basketball.
    b. I played basketball last week.

While tense deals with the relationship between RT and UT, aspect deals with the relationship between RT and ET. For example, the perfective aspect situates ET inside the time interval established by RT (ET $\subseteq$ RT). However, the perfect aspect situates ET before RT (ET < RT). In 3a, RT is established as a past time that occurred the day before UT as denoted by the adverbial *yesterday*, and further the event of basketball watching was completed within that RT. For (3b), the perfect construction using the auxiliary *have* marked for past tense tells us that the the RT is before UT (past tense) and further the RT is the time interval at which the speaker arrives at the party. The perfect aspect marked on the main verb with the past participle *–en* tells us that ET is before RT. That is, the 'eating' event takes place prior to the 'arriving' event.

(3) a. Yesterday, I watched the basketball game.
    b. When I arrived at the party, I had already eaten.

In English, the temporal adverbials and contextual information serve to provide additional information about the reference time, but for languages that lack overt tense morphology, the reference time is only established in the discourse context or using temporal adverbials. In (4a) for Kaqchikel, an utterance marked with the imperfective aspect is underspecified for temporal reference, so any of the three given translations are possible. However, for (4b), the reference time is established by the presence of the temporal adverbial *iwïr pa tiqaq'ij* 'yesterday in the afternoon'.

(4) a. y-i-wär
IMPF-B1S-sleep
'I was sleeping/am sleeping/will be sleeping.'
b. y-i-wär iwïr pa tiqaq'ij
IMPF-B1S-sleep yesterday PRE afternoon
'I was sleeping yesterday in the afternoon.'

Unlike the Kaqchikel data in (4a), St'át'imcets finite clauses, which are only marked for person/number agreement, are restricted to non-future reference times. In (5), (5a) shows that both a past and present reference time is available, which is suggestive of a tenseless clause. However, (5b) is unacceptable when combined with a future denoting adverbial suggesting that perhaps a covert non-future tense is responsible for the reference time restriction. Matthewson (2006) refers to such utterances as superficially tenseless sentences, or STSs. In (5), the STS is only felicitous when the interpretation is a non-future reference time, as indicated in the contrast between (5a) and (5b), which appears with future denoting temporal adverbials. The example in (5c) illustrates that the utterance can combine with non-future denoting adverbials.

(5) a. sáy'ez'-lhkan
play-1SG.SUBJ
'I played/I am playing' (Matthewson, 2006: p. 676)
b. *sáy'ez'-lhkan natcs/zánucwem
play-1SG.SUBJ one.day.away/next year
Intended: 'I will play tomorrow/next year. (Matthewson, 2006: p. 677)
c. sáy'ez'-lhkan i-tsilkstásq'et-as
play-1SG.SUBJ when.PAST-Friday-3CONJ
'I played on Friday.' (Matthewson, 2006: p. 677)

Matthewson (2006) proposes that the non-future temporal restriction is due to a phonologically empty tense morpheme TENSE. Further, she claims that any future-oriented utterances must receive overt marking, and the future interpretation is akin to the WOLL analysis for English *will* and *would* as proposed in Abusch (1985), where each form is composed of WOLL, a future-shifting operator, plus tense. Under this analysis, the prediction is that a language only allows future readings when overt morphology is present. In (6), Matthewson analyzes *kelh* as the overt spellout of WOLL in St'át'imcets, which is underlyingly the non-future TENSE plus the future-shifting operator.

(6) sáy'ez'-lhkan kelh
play-1SG.SUBJ *kelh*
'I will play.' (Matthewson, 2006: p. 677)

In a separate study on Guaraní, Tonhauser (2011) observes that the data is similar to St'át'imcets in that matrix clauses only marked for person/number agreement (i.e. superficially tenseless) have the same non-future restriction, which warrants consideration of a covert tense analysis as well. However, on the assumption that the non-future covert tense morpheme must be present in all matrix clauses, the tensed analysis for Guaraní leads to problems accounting for the behavior of some subordinate tenseless clauses and for non-initial matrix clause conjuncts, which do actually license future reference times. To make a tensed analysis work, certain stipulations would be necessary to account for these cases. Thus, a tenseless analysis of Guaraní is a simpler approach and accounts for the various problematic cases for the tensed approach making it the preferred analysis for Tonhauser.

Data from other languages including Kalaallisut (Bittner, 2005), Chinese (Smith and Erbaugh, 2005; Lin, 2006), and Hausa (Mucha, 2013), among others, have also contributed to the discussion on the status of tense in languages that lack overt tense morphology. The primary focus of this paper is to add to the discussion with an analysis of the Kaqchikel temporal system and address the open question as to whether or not tense is encoded in the language. Although Kaqchikel differs from both St'át'imcets and Guaraní in that finite verbs are never unmarked for aspect or mood, the data leads to the conclusion that Kaqchikel is best analyzed as a tenseless language. Further, the non-future temporal restriction in clauses only marked for aspect or mood does not apply to Kaqchikel as with both St'át'imcets and Guaraní, which strengthens the argument for a tenseless analysis. In order to motivate this conclusion, I provide a description of Kaqchikel aspect and mood in §2. §3 discusses both a tensed and a tenseless approach for Kaqchikel finite matrix clauses, and §4 considers reference times of subordinate clauses. I conclude in §5.

2. Introduction to (T)AM in Kaqchikel

Turning now to Kaqchikel, the first important difference, as already mentioned, is that unlike both St'át'imcets and Guaraní, all finite verbs are obligatorily marked with one of four (tense)-aspect-mood ((T)AM) markers, which are given in Table 1.

Morpheme	Function
n-/y-/nk-	Imperfective aspect
x-	Perfective
xt-/xk-	Potential mood
t-/k-	Imperative/hortative mood

Table 1: (T)AM morphemes and functions

In addition to being inflected for (T)AM, verbs are marked for person/number agreement. The basic verbal template for Kaqchikel is given in (7), where Set A refers to the ergative agreement markers and Set B refers to the absolutive agreement markers. Kaqchikel displays an ergative/absolutive alignment where intransitive subject arguments are marked the same as transitive objects (Set B) and the subjects of transitive arguments are marked with a different set of agreement markers (Set A). Examples for fully inflected verbs for the imperfective and perfective aspect are given respectively in (8a–8c). Both (8a) and (8b) are intransitive, so only Set B markers are used for agreement, but (8c) shows use of a transitive verb marked with both the Set A and Set B markers.

(7) (T)AM-SETB-SETA-verb-(optional suffixes)

(8) a. y-in-atin
IMPF-B1S-bathe
'I was/am/will be bathing.'
b. x-in-atin
PRFV-B1S-bathe
'I bathed.'[2]
c. y-at-in-tz'ët
IMPF-B2S-A1S-see
'I see you.'

In addition to the frequently used imperfective and perfective aspects, the potential and hortative/imperative moods are also available to fill the (T)AM slot, which are exemplified in (9a–9c) respectively. Note that (9b) is a regular second person singular imperative, but (9b) is in the third person singular and shows the hortative use of the marker.

(9) a. xk-i-wär
POT-B1S-sleep
'I will sleep.'
b. k-a-pa-e'
IMP-B2S-stand-ITV
Stand!
c. t-u-mestaj
IMP-B3S-forget
'May he forget.'

For the present study, I focus only on the perfective, imperfective and potential markers. In the next section, both a tensed and tenseless analysis of the morphemes and of the finite clauses in which they appear are considered.

[2]The non-past interpretation of the perfective utterance is judged to be infelicitous to native speakers. However, a non-past reading is possible when enough context is added, which is discussed further in §3.2.

3. Status of 'tense' in Kaqchikel

In this section, I consider both a tensed and tenseless analysis for finite verbs in Kaqchikel. Previous descriptions of (T)AM in Kaqchikel vary on this point. Rodríguez Guaján and García Matzar (1997) analyze the language as tenseless, but only the imperfective is shown as being compatible with various RTs. Brown et al. (2006), although pedagogical, refers to the imperfective also as a present tense, the perfective as a past tense, and the potential as a future tense. Because of the lack of consensus and lack of evidence to support a tenseless analysis, each morpheme is potentially responsible for introducing grammatical tense. Further, the possibility that covert tense is responsible for introducing the RT remains in the instance that the aspect/mood markers are shown to not encode tense. To discern between a tensed or tenseless analysis of Kaqchikel there are three hypotheses to test here:

1. The aspect/mood morphemes are also encoding tense, so there is no covert tense present because tense is overtly indicated by the aspect and mood markers in addition to aspect/mood information.

2. The aspect/mood morphemes are not encoding tense and only aspect/mood information. Tense is thus a covert morpheme restricting reference times. Additionally, to get future interpretations, special morphology must be used.

3. There is no covert or overt tense restricting reference times in Kaqchikel. Reference time is supplied only by temporal adverbials and in the discourse context.

For each hypothesis above, I provide tests for each morpheme to determine the status of tense.

3.1. Hypothesis 1: *Kaqchikel TAM morphemes encode aspect/mood+tense*

To test for the first hypothesis, I evaluate whether or not any of the three aspect/mood markers are restricted to only one reference time interval, which includes consideration of a past/present distinction or the non-future only distinction. If any of the morphemes encodes grammatical tense, the expectation is that they will be incompatible with temporal adverbials denoting various RTs with respect to utterance time. A further test that I employ in this section considers temporal adverbials that are ambiguous with respect to RT, which is exemplified in (10) with *at 6 o'clock in the morning*, where the tense in English restricts the interpretation of the adverbial as a past/present/future RT. In (10a), the past tense restricts the time interval to a past RT, so the temporal adverbial denotes a past time that coincides with 6 o'clock in the morning. However, (10b) refers to a future 6 o'clock in the morning with respect to UT.

(10) a. I woke up at 6 o'clock in the morning.
b. I will wake up at 6 o'clock in the morning.

If an underspecified temporal adverbial remains underspecified (setting aside interpretation preferences for the moment) with any of the aspect/mood morphemes in Kaqchikel, it suggests that tense is not being encoded by a given aspect/mood marker as is the case for English in (10).

Starting with the imperfective, we already saw that past/present/future RTs are available, as exhibited by (8a), which already points in the direction of a tenseless analysis of at least the imperfective aspect. To further support this claim, (11) shows that matrix clause verbs marked with the imperfective aspect are compatible with past (11a), present (11b) and future (11c) denoting temporal adverbials. Just a brief note that although the imperfective alone can be used for the progressive meaning, use of the periphrastic progressive with the auxiliary *tajin* is preferred by the speakers I work with to distinguish between the progressive and other imperfective meanings, which is shown by the non-progressive habitual interpretation shown in (12). However, the temporal reference restrictions are unaffected by use of the periphrastic form over the imperfective (i.e. RT is still underspecified and future RTs are possible). In some dialects, the progressive auxiliary is also marked with the imperfective aspect, but in the Sololá dialect only the unmarked *tajin* is used.

(11) a. Iwïr tajin y-e-xajon
yesterday PROG IMPF-B3P-dance
'Yesterday, they were dancing.' (RT<UT)

b. Wakamï tajin y-e-xajon
now/today PROG IMPF-B3P-dance
'They are dancing now.' (RT=UT)

c. Chwaq tajin y-e-xajon
tomorrow PROG IMPF-B3P-dance
'Tomorrow, they are dancing.' (RT>UT)

(12) q'ij q'ij y-in-atin
day day IMPF-B1S-bathe
'I bathe daily.'

Looking at the second test using underspecified temporal adverbials, I return to the example given in (11b) with the temporal adverb *wakamï*, which can either be used to mean 'now' or 'today'. The same utterance can be translated as *Today, I was dancing/Now, I am dancing/Today, I will be dancing*. In order to establish whether the utterance is to be interpreted as past, present, or future, additional context is necessary. In a context where the RT is established as a future RT, (13) is no longer ambiguous between 'today/now' interpretations and further the non-future interpretations are no longer available.

(13) [Context: What will you be doing later when I get home from work?]
tajin y-i-xajon wakamï
PROG IMPF-B1S-dance now/today
'I will be dancing today/#I am dancing now.'

Given that the imperfective aspect is compatible with any RT and is insufficient for determining the RT of underspecified temporal adverbials, the evidence strongly supports an analysis of the imperfective marker not marking tense.

The perfective aspect is less freely shifted into different reference times. In out of the blue contexts, speakers find non-past interpretations to be infelicitous.

(14) x-i-jote' ch-u-wi jun juyu
PRFV-B1S-ascend PRE-A3S-RN one mountain
'I climbed a mountain/#I will have climbed a mountain.'

Further, it is not possible to use non-past denoting temporal adverbials with the perfective aspect, which is shown in (15b). For (15a), the adverb *iwïr* is felicitous, but speakers judge use of the adverb *chwaq* 'tomorrow' to be bad in (15b) and tend to offer the explanation that use of *x-* must be in the past.

(15) a. Iwïr, x-i-jote' ch-u-wi jun juyu
yesterday PRFV-B1S-ascend PRE-A3S-RN one mountain
'Yesterday, I climbed a mountain.'

b. '#Chwaq x-i-jote' ch-u-wi jun juyu
tomorrow PRFV-B1S-ascend PRE-A3S-RN one mountain
Intended: 'Tomorrow, I will have climbed a mountain.'

Underspecified temporal adverbials are also interpreted as past denoting when used with the perfective aspect. Taking the adverbial *wakamï* again, the future interpretation as an event occurring sometime later that day is not possible.

(16) [Context: When is your mother coming to visit?]
x-ø-pï wakamï.
PRFV-B3S-arrive now/today
'She arrived today/#She will have arrived (by) today.'

Both (15a) and (15b) point in the direction of analyzing the perfective aspect as also being restricted to past reference times and thus encoding a past tense. However, as Tonhauser (2011) points out, more complex utterances need to be considered before reaching a conclusion or at least richer contexts which allow for the past RT interpretations to be overridden. In fact, combining both a richer context and a future denoting temporal adverbial allows for non-past reference time for the perfective aspect. In (17), the context establishes that the party under discussion is at a future time. The temporal adverbial is underspecified as to whether 8 o'clock is before or after utterance time, but in the given context it can only be interpreted as a future 8 o'clock, which constrains the RT of the entire utterance to a future time interval.

(17) [Context: You and a friend are planning a party for 9 o'clock that night. Your mother is baking the cake for the party, and your friend is worried that she won't be there with the cake in time. You tell her:]
Pa taq a las 8 chaq'a wakamï, x-ø-pï yan
PRE when PRE(Sp) DET(Sp) eight night now/today PRFV-B3S-arrive PAR
nu-te'
A1S-mother
'By 8 o'clock tonight, my mother will have already arrived.'

In spite of the fact that non-past interpretations do not easily arise with the perfective aspect, examples like (17) exclude the possibility of an analysis of the perfective aspect as an absolute past tense in Kaqchikel.

Similarly, the reference time for the potential mood is not easily shifted to times other than the future. In absence of additional context or a temporal adverbial, utterances with the potential mood are always interpreted with future reference times, so for (18) only the future interpretation is available.

(18) xk-i-b'iyin pa ri tienda
POT-B1S-walk PRE DET store(Sp)
'I'll walk to the store/#I was going to walk to the store.'

Temporal adverbials are also restricted with the potential mood, where only future denoting adverbials are felicitous, such as *chwaq* 'tomorrow' but not *iwïr* 'yesterday'

(19) xk-i-b'iyin pa ri tienda chwaq/iwïr
POT-B1S-walk PRE DET store(Sp) tomorrow
'I'll walk to the store tomorrow/#yesterday.'

When combined with the temporal adverbial *wakamï* 'today/now', again only a future interpretation is found to be available to speakers. In (20), the context establishes that the speaker is referring to a time prior to UT, which should allow the interpretation of the 'earlier today' reading and not just the 'later today' reading. However, the context is not sufficient for shifting the reference time of the utterance nor the interpretation of *wakamï* to a past interpretation. The response in (20) can only be interpreted as the 'I will go to the store today.'

(20) [Context: You are asked if you've already been to the store to get groceries for the week. You respond:]
xk-i-b'iyin pa ri tienda wakamï
POT-B1S-walk PRE DET store(Sp) now/today
Intended: 'I was going to go to the store (earlier) today.'

Just as with the perfective aspect, the data up to this point suggest that the potential mood is restricted to future reference times. However, the following examples show that the potential mood can be used when a past reference time is established in complex utterances. The first example is taken from *Ri Kitzijon kan ri Qati't Qamama'*, a children's book containing traditional folk narratives. The first line in (21a) establishes that this is a story that takes place during a past time interval. In (21b), the verb marked with the potential mood is in the subordinate relative clause under the belief-predicate *nojij* 'to think/believe'. The time at which they believed they would be eaten by the jaguar is established as a time that follows the time the animal roars but precedes the time at which they see the cat fighting the jaguar in (21c). In this example, the potential is not interpreted as an absolute future reference time.

(21) a. K'o cha' jun q'ij x-ka-k'axaj jun chikop n-ø-sik'in chunaqaj ri
EXST QUOT one day PRFV-B3P-hear one animal IMPF-B3S-call near DET
ko-choch.
A3P-house
'One day they heard the roar of an animal near their houses.'

b. Janila' x-ø-ki-xib'ij ki' r-uma x-ki-nojij che ri chiköp
very PRFV-B3S-A3P-scare 3P B3S-RN PRFV-B3P-think REL DET animal
xk-e-ru-tïj
POT-B3P-A3S-eat
'They were frightened because they thought the animal was going to eat them.'

c. Xa ja k'a ri ti ki-me's x-u-pab'a' ri ch-u-wäch jun
PAR FOC PAR DET DIM 3P-cat PRFV-B3S-stand.up DET PRE-B3S-face one
b'alam.
jaguar
'But it was their cat that stood up in the face of the jaguar.'

The second example of a potential mood in a non-future reference time contains the phrase *ri' ojer* 'the past' in the same clause as the verb marked with the potential, which is clearly establishing a non-future reference time for the clause and further for the entire utterance.

(22) kan xk-a-ch'oj-in ri' ojer, ma jun tä ri' kuy-un-ïk
INTS POT-B2S-demand-AP DET past NEG one IRR DET forgive-AP-INF
'In the past, even if you demanded it, there was no forgiveness.' (González, 2016: 35)

Both (21) and in (22) provide strong evidence that the potential mood is also not contributing temporal reference and should be analyzed as only a mood marker.

Summarizing the findings for hypothesis 1, there is sufficient evidence to conclude that none of the three markers is contributing temporal reference, so at this point Kaqchikel looks to be a tenseless language unless testing hypothesis 2, a cover tense analysis, reveals restrictions on reference times for clauses marked for aspect/mood.

3.2. Hypothesis 2: *Kaqchikel has covert tense*

Hypothesis 1 and hypothesis 2 are closely related and the data from the previous section already suggests that a covert tense analysis is unlikely for Kaqchikel. A covert tense analysis relies on temporal restrictions for clauses not overtly marked for tense, so underlyingly all finite clauses are assumed to be marked with a phonologically empty tense morpheme, TENSE. For both Guaraní and St'át'imcets, the temporal restriction is to non-future times, but additional covert temporal restrictions are possible (e.g. a covert past tense). Under the assumption that covert tense is restricting reference times, finite matrix clauses are predicted to be only interpreted with restricted temporal reference. However, we already saw that this is not the case for Kaqchikel. Namely for finite matrix clauses marked with imperfective aspect and the potential mood, temporal reference is not restricted to any specific RTs. Focusing on the restrictions observed in other languages on future reference times, the examples in (23) and (24) demonstrate that both past and future temporal reference are available if a salient RT is established. If a future RT is established in context or by a temporal adverbial, future interpretations are available for Kaqchikel. For (23), the context preceding the target utterance marked with the imperfective aspect introduces a salient reference time that restricts the RT of the response to past RTs. However, in (24), the context introduces an RT, which is in the absolute future of UT.

(23) [Context: You called your friend earlier that morning, but she didn't answer. You see her later and ask what she was doing that morning:]
(tajin) y-in-samäj
(PROG) IMPF-B1S-work
'I was working.'

(24) [Context: Your friend wants to get dinner later that evening. You are unable to attend, so she asks what you will be doing instead. You respond:]
(tajin) y-in-samäj
(PROG) IMPF-B1S-work
'I will be working.'

Given that matrix clauses in Kaqchikel are not restricted to non-future RTs, there is no evidence that a phonologically empty non-future tense morpheme is restricting the temporal reference of an utterance. Rather, Kaqchikel temporal reference is established in the discourse context or with temporal adverbials. However, this does leave open the question as to how temporal reference is established in out-of-the-blue contexts, but I reserve further discussion for §4.

In addition to the implications for past and present RTs, the covert tense analysis has implications for how to analyze future discourse in languages that are (at least) superficially tenseless like St'át'imcets. Matthewson (2006) argues that there is no absolute future tense category and future discourse is realized by the combination of tense (covert or overt) and a prospective aspect. The prospective aspect acts as a future-orienting operator that shifts the ET to a future time of the RT rather than the UT. This accounts absolute future interpretations in which the RT is at UT, so the ET is shifted to a time that temporally follows RT (RT<ET, RT=UT). It also accounts for future of the past interpretations, where the reference time is established a past RT

and ET temporally follows RT (RT<ET, RT<UT) giving rise to ETs that can still be in the past with respect to UT or after as exemplified for English in (25).

(25) a. A child was born who will become ruler of the world.
b. A child was born who would become ruler of the world. (Kamp, 1971)

An additional feature of the covert tense analysis is the proposal that special morphology or marking is required in order to get future interpretations, such as *kelh* in St'át'imcets. Recall that clauses for St'át'imcets cannot be interpreted as having absolute future reference times. Rather, the marker *kelh* situates the event time of the utterance to a time that temporally follows the reference time (RT<ET). If an utterance is interpreted with a future reference time for an event, this is due to the combination of TENSE restricting the reference times to non-future times plus *kelh*, which is shown in the contrast between (26) and (27) both repeated here for convenience. For (26), the reference time is restricted to either a past or a present time interval, but when *kelh* is used in (27), the playing event is shifted to a time after RT. In this case, the RT is the same as UT, so the absolute future interpretation is expected.

(26) sáy'ez'-lhkan
play-1SG.SUBJ
'I played/I am playing.' (Matthewson, 2006: p. 676)

(27) sáy'ez'-lhkan kelh
play-1SG.SUBJ *kelh*
'I will play.' (Matthewson, 2006: p. 677)

Data from St'át'imcets (in Matthewson, 2006), Guaraní (in Tonhauser, 2011), and Hausa (in Mucha, 2013) all provide cross-linguistic evidence that (at least some) instances of future reference times do require special morphology (prospective aspect). However, according to Mucha (2013) Hausa allows for future interpretations for clauses marked with the continuous aspect, which is shown in (28).

(28) Su-ǹn wàsà
3PL-CONT play
'They are playing/(were playing)/(will play)' (Mucha, 2013: p. 372)

Again, the Hausa data looks quite similar to the Kaqchikel data from (24), where no additional morphology is required for the utterance to be interpreted with an absolute future RT. Because neither components of the covert tense analysis apply to the Kaqchikel data, the remaining hypothesis, that Kaqchikel is a truly tenseless language, is likely to be the preferred analysis.

3.3. Hypothesis 3: *Kaqchikel is tenseless*

To summarize the results of testing for hypothesis 1 and hypothesis 2, we already saw that hypothesis 1 (*Kaqchikel TAM morphemes contribute aspect/mood+tense*) is ruled out because each of the aspect/mood morphemes lacks any restrictions for temporal reference ignoring restrictions due to pragmatic principles, which will be discussed in the next section. Hypothesis 2 was then ruled out because finite matrix clauses in Kaqchikel are not restricted to non-future reference times nor are any other reference time restrictions (i.e. a non-past restriction) present in the data. Further, future temporal reference is available for utterances that are otherwise unmarked for a prospective aspect (in the sense Matthewson's future-shifting operator). Discourse context and temporal adverbials are sufficient for giving rise to future RTs. This leaves open the question as to whether or not hypothesis 3 that Kaqchikel is tenseless is, indeed, the most suitable analysis of Kaqchikel. Evidence that no overt or covert morphological marking in the language restricting the reference time in a given utterance (or finite clause) has already been discussed. Instead of rehashing these points, I turn to additional evidence that comes from future discourse in the language.

To realize future discourse in Kaqchikel, more than one option is potentially available. Tonhauser (2011) refers to the two possible options for how languages realize future discourse as the *reference time option* and the *eventuality time option*. The ideas are developed from a similar analysis of how eventualities are situated with respect to utterance time in more than one way (Reichenbach, 1947). Tonhauser (2011) appeals to the two possible options in order to discuss how an eventuality can be situated in the absolute future of UT. If future discourse is realized by the reference time option, there must be a salient reference time in the absolute future, and the ET is then situated as occurring in the absolute future of the UT. On the other hand, the eventuality time option assumes that all utterances have a past or present RT, and future discourse is realized by situating the ET at a time that temporally follows the RT. Tonhauser (2011) analyzes Guaraní as a language that relies on the eventuality time option, whereas English *will* constructions are an example of the reference time option.[3] I analyze Kaqchikel as a language that uses both the eventuality time option and the reference time option (with restrictions).

Because I analyzed Kaqchikel as a tenseless language, it may seem as though the reference time option for future discourse is ruled absence of grammatical tense. However, in principle it should still be available so long as there is a means for indicating absolute future temporal reference in the language. In (29), the temporal adverbial *chwaq* 'tomorrow' introduces an absolute future reference time because the speaker is talking about the day in the absolute future of utterance time. Note that the verb is marked with the imperfective aspect, which we already know is the only aspect marker easily shifted into different reference times using only a temporal adverbial or in context.

(29) Chwaq y-i-jote' ch-u-wi jun juyu
tomorrow IMPF-B1S-ascend PRE-A3S-RN one mountain
'Tomorrow, I'll climb a mountain.' (UT<RT$\supseteq$ET)

The eventuality time option is also available for the imperfective aspect. In (30), the temporal adverbial *iwïr* 'yesterday' restricts the RT of the utterance to the past. However, the temporal

[3] This is on the assumption that English *will* introduces an absolute future reference time in contrast to the WOLL analysis given in Abusch (1985). This also contrasts to the 'eventuality time' option in English with the *is/are going to* construction, which has a present tense RT and the ET temporally follows the RT.

adverbial *chaq'a wakamï* 'tonight' situates the ET after RT, which is also located in the absolute future of UT.

(30) Iwïr, Maria x-i-ru-b'ij chï n-ø-pe chaq'a wakamï
yesterday Maria PRFV-B1S-A3S-tell REL IMPF-B3S-come night today/now
Yesterday, Maria told me that she is coming tonight.'

The perfective aspect, though difficult to shift to non-past RTs, can also realize future discourse with the reference time option. The earlier example of the perfective aspect shifted to a future RT (17) (partially repeated here for convenience) relies on the temporal adverbial *pa taq a las 8 chaq'a wakamï* 'By 8 o'clock tonight' constrains the RT of the utterance to a future time. The RT is in the absolute future of the UT, and the event of the mother's arrival, or the ET, is a completed event at or before RT.

(31) Pa taq a las 8 chaq'a wakamï, x-ø-pï yan
PRE when PRE(Sp) DET(Sp) eight night now/today PRFV-B3S-arrive PAR
nu-te'
A1S-mother
'By 8 o'clock tonight, my mother will have already arrived.' (UT<RT⊆ET)

Future discourse can also be realized using the eventuality time option for the perfective as well, but it also achieved with similar difficulty as the reference time option. However, the example in (32) is constrained to a past RT by the temporal adverbial *iwïr* 'yesterday'. The first event in the utterance is the saying event, which also occurs at a past time, but the temporal interpretation of the second clause containing the event of finishing the work is temporally located in the absolute future.

(32) Iwïr, Maria x-i-ru-b'ij chï x-ø-ru-k'is ru-samaj chaq'a
yesterday Maria PRFV-B1S-A3S-tell REL PRFV-B3S-A3S-finish A3S-work night
wakamï
today/now
'Yesterday, Maria told me that she will have finished her work by tonight.'

Finally, the potential mood is the only marker that I argue is restricted to the eventuality time option for future discourse. If the potential were actually a future marker, then all utterances could be interpreted as taking place in the absolute future. A further consideration is the difference between speaker choice for when to use the imperfective or the potential to describe incomplete events, such as the contrast in (33). In (33a), the imperfective aspect is used to describe the event of walking to the store at a future time. For (33b), the potential mood is used. Speaker intuitions about the difference in these examples is that the imperfective is used when there is more certainty that the event will occur, while the potential mood introduces more uncertainty of the realization of the event.

(33) a. y-i-b'iyin pa ri tienda chwaq
IMPF-B1S-walk PRE DET store(Sp) tomorrow
'I will walk to the store tomorrow.'

b. xk-i-b'iyin pa ri tienda chwaq
POT-B1S-walk PRE DET store(Sp) tomorrow
'I'll (potentially) walk to the store tomorrow.'

I argue that the RT of (33a) is a future RT (UT<RT), but the RT in (33b) is the time of utterance (UT=RT). The event description of walking to the store takes place at a time interval in the absolute future of UT, but the potential for the event to take place is only at the time the sentence is uttered. A further example of the potential mood in future discourse is given in (34). The example comes from one of the folk stories in *Ri Kitzijon kan ri Qati't Qamama'*. Prior to this in the story, a group of animals is approaching a woodpecker to ask for a favor. They need a hole drilled in a stone in order to reach food. The response of the woodpecker is in (34). Although the narrative itself takes place in the past, the clauses of concern are those embedded under *–b'ij* 'to say/tell'. He offers them a deal that in exchange for the favor they ask, he wants a dress (costume) that they have. The RT for the speech act introducing the wish or request by the woodpecker is the time he utters it, but the events described are in the absolute future of UT.

(34) X-u-b'ij chi-ke chï xt-u-k'öt ri abäj we xti-ki-sipaj yan
PRFV-A3S-tell RN-3P REL POT-A3S-drill DET stone REL POT-A3P-give.a.gift PAR
tzyäq chi-re.
dress RN-3S
'He [the woodpecker]told them he will drill the hole in the stone if they give him the dress.'

4. Interpretational preferences

For the remainder of the paper, I address the question introduced earlier in the paper about why different aspect/mood markers have interpretational preferences in out-of-the-blue-contexts or in underspecified contexts. For instance, all three markers discussed here have interpretational preferences, of which some are stronger than others (i.e. less easy to override with context). The imperfective tends to be interpreted with present temporal reference, the perfective with the past RT, and the potential with the future. In order to account for these preferences that arise in Kaqchikel, I turn to a pragmatic approach as discussed in Smith et al. (2003), Smith and Erbaugh (2005) and Smith et al. (2007) but also related to approaches developed in Bohnemeyer (1998) for Yucatec Maya and Mucha (2013) for Hausa.

The first principle deals with the deictic nature of speech, which is simply that events are described in a deictic relationship to speech time. When interpretational preferences arise, they are always situated with respect to UT. Additionally, the structure of the event described (telic/atelic, stative, etc.) affects the 'default' interpretation. The following are the observed deictic patterns for preferred interpretations as given in Smith and Erbaugh (2005).

1. Ongoing events are in the present

2. States (unbounded) are in the present

3. Bounded events are in the past

4. Explicit temporal reference may override [any of the above] (Smith and Erbaugh, 2005: p. 715)

The deictic principles offer a preliminary view of how eventualities are situated with respect to utterance time, but it stops short of explaining why, for example, bounded events are interpreted in the past and why some interpretational preferences are more difficult to override.

First, bounded events are events that are completed (though whether the boundedness includes both the initial point and terminal point is language dependent), and generally, completed events occur prior to utterance time. When shifting a bounded event to a future temporal interval, the event is still considered a completed within the time interval. Because bounded events must be completed within the time interval denoted by the RT, bounded events are not compatible with a present reference time. For Kaqchikel, this explains the restriction for the perfective aspect to past and sometimes future time intervals. Smith and Erbaugh (2005) refer to this as the *bounded event constraint*. The bounded event constraint is simply that bounded events are not located in the present.

The final pragmatic principle of relevance is the *simplicity principle of interpretation*. This principle simply states 'choose the interpretation that requires the least additional information' (Smith and Erbaugh, 2005: p. 717). Under this principle, we can account for why perfective, or bounded, events in Kaqchikel are more easily interpreted at past RTs and require a much richer context in order to shift the RT to the future as does a shift from a future interpretation to a past interpretation for the potential mood.

By considering pragmatic principles when trying to understand temporal reference in a language like Kaqchikel, it allows for a much simpler analysis as a tenseless language. It predicts that, although interpretational preferences arise due to the structure of the event described in an utterance, these preferences are due to pragmatics and not by underlying semantic machinery, such as covert tense. While a tensed analysis works for languages like St'át'imcets, it fails to account for the patterns in Kaqchikel. To analyze Kaqchikel as a tenseless language, in which temporal reference is established in context, with temporal adverbials, or via interpretational preferences driven by pragmatic principles, is thus the preferred analysis.

5. Conclusion

In summary, this paper provides an analysis of Kaqchikel temporal reference by showing that neither overt or covert tense is present in the language. Ultimately, temporal reference in utterances is interpreted using alternative means. The results of the present study contribute data from a new language to add to a growing typology of how temporal reference is established cross-linguistically. Additionally, this work sets the stage for future research evaluating other aspects of Kaqchikel that contribute to temporality, such as temporal particles and information structure.

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Restrictions on subkind coercion in object mass nouns[1]

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Abstract. Rothstein (2015) raises the following puzzle. Why should it be the case that mass nouns like *rice* receive a coerced taxonomic plural reading when directly modified by a numerical expression, but object mass nouns like *furniture*, *jewellery* and *crockery* do not? For example, *three rices* can mean THREE KINDS OF RICE, but *three furnitures* cannot mean THREE KINDS OF FURNITURE. We attempt to solve this puzzle by providing an analysis of kind readings for concrete count and mass nouns generally, which is based on the analysis of their non-kind predicate readings in Sutton and Filip (2016a). The key property driving our analysis is the extensional overlap of subkinds at each level of categorisation. Object mass nouns have extensionally overlapping subkinds relative to a level of categorisation, while other mass nouns do not. We also differentiate between count and mass nouns in terms of counting contexts. Artefact denoting count nouns such as *vehicle* have a felicitous taxonomic plural, because, on our account, count nouns are linked to specific counting contexts, which force the resolution of potential overlap between objects in their denotation. Artefact denoting mass nouns such as *furniture* do not have a felicitous taxonomic plural, because mass nouns are saturated with the null counting context which leaves any overlap in the noun's subkind structure unresolved.

Keywords: kinds, subkinds, taxonomic plurals, count/mass distinction, context sensitivity.

1. Introduction

Concrete mass nouns can be generally coerced into count noun interpretations, PORTION or SUBKIND, modulo context (as is well known since at least Pelletier (1975)). Different classes of nouns differ with respect to the ease with which they can be coerced into a count interpretation. For example, *water* in (1a)-(1b) is easier to coerce into a count noun interpretation than *rice* in (2a)-(2b), while count interpretations of *mud* are possible only in highly specialised contexts such as in (3a)-(3b).

(1) a. Three waters, please!
e.g. three [GLASSES/BOTTLES OF] water. (portion)
b. I ordered three waters for the party: still, sparkling, and fruit-flavoured for the kids.
i.e. three [KINDS OF] water (subkind)

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(2) a. We ordered the main courses with two plain rice, one egg fried rice and a nan, more than enough for the four of us.[2]
e.g. two [PORTIONS OF] plain rice. (portion)
b. *Context: three kinds of rice, Calmati, Texmati, Kasmati*
These three rices have basmati's viscosity and cooking style, but smaller individual grains.[3]
i.e. three [KINDS OF] rice (subkind)

(3) *Context: yield points of different mud samples before contamination*
The three muds experienced particles dispersion at the same temperature with different yield points.[4]
a. The three [SAMPLES OF] mud… (portion)
b. The three [KINDS OF] mud.… (subkind)

Object mass nouns (which have also been called, *inter alia*, 'fake' or 'neat' mass nouns) include, in English, *furniture*, *footwear*, *cutlery*, *crockery*, *equipment*. These nouns are, like prototypical count nouns such as *chair* and *cat*, considered to be 'naturally atomic' in that "what counts as one entity is not determined by context but by the naturally atomic structure of the stuff. What counts as one *P* is part of our knowledge of what a *P* is" (Rothstein, 2010). What is remarkable and complicates the analysis of this subset of mass nouns derives from the observation that objects that count as one *P* in the denotation of a given object mass *P* stand in a network of kind-subkind relations. For example, *furniture* is a SUPERORDINATE CATEGORY term in that its constituent members comprise terms for BASIC LEVEL categories: *table, chair, bed*, etc. Basic level categories, in turn, subsume members labeled by SUBORDINATE LEVEL categories: for *chair*, we have *kitchen chair, dentist chair*, for instance. There is also a level of subkinds of superordinate categories: for FURNITURE, we have *bedroom furniture*, which is a kind of *furniture*.

1.1. The puzzle: Rothstein (2015)

Object mass nouns strongly resist coercion in numerical count constructions, in which either specific ordinary individuals of the same (sub)kind or different (sub)kinds are counted. For example, in (4a), we see a resistance to the grammatical counting of individual items of furniture (that realise basic-level kinds). In (4b), we see resistance to counting basic level kinds, and in (4c), we see resistance to counting superordinate-level kinds.

(4) a. #I ordered three furnitures from Ikea: one table and two chairs.
b. #I ordered two furnitures from Ikea: chairs and tables.
c. #I ordered two furnitures from Ikea: bedroom and living room furniture.

[2]`http://www.derbytelegraph.co.uk/speciality-dishes-star-turn-littleover-s-red/story-20536589-detail/story.html` ACCESSED: 10/10/2016.

[3]*The Ultimate Rice Cooker Cookbook*, Harvard Common Press, 2003. p. 23

[4]From: Adekomaya, Olufemi A. 2013. Experimental analysis of the effect of magnesium saltwater influx on the behaviour of drilling fluids. Journal of Petroleum Exploration and Production Technology 3. 61–67.

This is puzzling because there are clearly identifiable and conceptually accessible 'atomic' entities in the denotation of object mass nouns (e.g., single items of furniture such as single tables or chairs), and yet they cannot be accessed via coercion. Subordinate categories labeled by object mass nouns have identifiable sub-/superkinds, and yet members at these levels cannot be accessed for grammatical counting in coerced environments, even when the relevant sub-/superkinds are easily retrievable from the context.

The above data are well-known, but rarely directly addressed, with a few notable exceptions. Among the recent ones is Sutton and Filip (2016a) dealing with the restrictions on grammatical counting of object mass nouns that concerns the cardinality of ordinary objects that realise basic-level kinds (4a). Rothstein (2015), as a side observation, raises the question about the lack of pluralisation with a subkind interpretation (illustrated by our example (4b) above): If mass nouns like *water* (1b) can pluralise with a coerced taxonomic subkind interpretation, why do object mass nouns not have such taxonomic plurals? However, the answer to this question lies beyond the scope of her main agenda. A recent attempt at answering this question can be found in Grimm and Levin (2016), who focus on the failure of artefact denoting nouns to form well-formed taxonomies (see Section 5). Building on some ideas of Sutton and Filip (2016a), in this paper, we pose our main question as follows: Why do object mass nouns resist mass-to-count coercion for counting taxonomic subkinds?

1.2. Superordinacy

The (apparent) SUPERORDINATE nature of object mass nouns like *furniture* cannot be what underlies the data. There are SUPERORDINATE COUNT nouns like *vehicle, weapon*, which are grammatically countable, and which have natural plurals with a subkind interpretation, as in (5a). Some of these have mass counterparts that cannot be coerced into countable subkind readings (5b).

(5) a. The brief for the government-backed project is to produce four vehicles ranging in size from the Ford Fiesta to the Vauxhall Cavalier.[5]
b. #The brief for the government-backed project is to produce four transports...

It is worth noting that the restriction on a coerced subkind interpretation of object mass nouns is less strict in other languages. For instance, in German, there are subkind readings for indefinite NPs formed with object mass nouns. Take *Gebäck* ('pastry' or 'baked good'), for instance, as in (6a). However, felicity is significantly worsened for direct numerical attachment, as in (6b). Such cross-linguistic differences have not yet been noticed, to our knowledge, but they lie outside of the scope of this paper and we plan to investigate them in our further research.

[5] `http://www.independent.co.uk/arts-entertainment/motoringfamily-planning-1577828.html` (15.03.2016).

(6) a. Ein Gebäck, das in der Osterzeit auf keinem Kaffeetisch fehlen darf,
A pastry REL in the Easter.time on no.DAT coffee.table lack.INF may.3SG
ist Mamoule.
be.3SG ma'amoul
'A type of pastry that is a must on any coffee table over Easter is ma'amoul.'[6]
b. #Ich habe zwei Gebäck gekauft: Schweineohren und Kekse.
I have.1SG two pastry buy.PAST pig.ear.PL and cookie.PL
Int: 'I bought two kinds of baked goods: palmier pastries and cookies.'

1.3. Outline

Object mass noun concepts like FURNITURE are associated with sub-/superkind structures that are inconsistent with a well-formed taxonomy, as has been observed (see e.g., Wierzbicka, 1985; Wisniewski et al., 1996). Related to this, we propose that they have sub-/superkind structures that overlap in their extensions, and such overlap cannot be contextually coerced into disjointness. To count kinds, overlap must be resolved; if overlap cannot be resolved, counting of 'kind units' goes wrong.

We implement this idea by relying on ideas independently introduced in three accounts of the mass/count distinction, which will be briefly summarized in Section 2: Rothstein (2010), Landman (2011), and Sutton and Filip (2016a). In Section 3, we give a semantics for kind readings of count and mass nouns by generalising restrictions on counting of particular individuals, proposed in Sutton and Filip (2016a), to restrictions on counting of kinds. In Section 4, we provide a semantics for explicit kind-extracting expressions such as *kind of* and *type of* and we show how our account from Section 3 can be used to derive the restrictions on subkind coercion. In Section 5, we briefly discuss Grimm and Levin (2016), the one other account of these data we are aware of, in the light of our analysis.

2. Background

2.1. Rothstein (2010): Count nouns are indexed to counting contexts

There is an agreement that prototypical mass nouns (*water, air*) are not naturally atomic (i.e., do not have stably discrete, non-overlapping objects in their denotation across all contexts), and are divisible (proper parts of Ps are also Ps). Building on Zucchi and White (1996, 2001) (and B. Partee, p.c.), Rothstein (2010) focuses on puzzling nouns, the denotations of which are divisible and not naturally atomic, but which are nonetheless lexicalized as count nouns. For example, take *fence*. What counts as a single fence is determined in context, so by Rothstein's definition, *fence* is not naturally atomic. Furthermore, nouns such as *fence* denote entities that are divisible in that a long fence could itself be divided up into smaller fence units, which also felicitously fall under the denotation of *fence*.

[6] Obtained from the DWDS corpus `https://www.dwds.de`

Rothstein's innovation is to introduce the notion of a counting context. Whereas mass nouns are of type $\langle e,t \rangle$, and denote sets of entities, count nouns are of type $\langle e \times k,t \rangle$ and denote *semantic atoms*, that is, atomic entities indexed to counting contexts. Grammatical counting is a context dependent operation. We count, in a particular context *k*, instances of the noun denotation which in that context are considered atomic instances of that noun denotation.

Count predicates are derived from number neutral 'root' predicates via a $COUNT_k$ operation. For example, suppose the root predicate *FENCE* denotes $\{f_1, f_2, f_3, f_4, f_1 \sqcup f_2, ..., f_1 \sqcup f_2 \sqcup f_3 \sqcup f_4\}$ (the set of atoms closed under mereological sum, $\sqcup$) and that there are two contexts k_1 and k_2:

$$
\begin{array}{rll}
FENCE_{\text{count}} & = COUNT_k(FENCE) = \{\langle d,k \rangle : d \in FENCE \cap k\} & \\
k_1 & = \{f_1, f_2, f_3, f_4, g_1, g_2, ...\} & \\
k_2 & = \{f_1 \sqcup f_2 \sqcup f_3 \sqcup f_4, g_1, g_2, ...\} & \\
COUNT_{k_1}(FENCE) & = \{\langle f_1, k_1 \rangle, \langle f_2, k_1 \rangle, \langle \{f_3, k_1 \rangle, \langle f_4, k_1 \rangle\} & \Rightarrow \textit{Four fences} \\
COUNT_{k_2}(FENCE) & = \langle f_1 \sqcup f_2 \sqcup f_3 \sqcup f_4, k_2 \rangle & \Rightarrow \textit{One fence}
\end{array}
$$

In default cases, applying $COUNT_k$ to a predicate at a context results in a disjoint set. In our analysis of kind readings for concrete nouns, we will, inspired by Rothstein (2010), also appeal to contexts as devices for yielding disjoint sets, and hence countable sets.

2.2. Landman (2011, 2016) on neat mass nouns

The central concept in Landman (2011, 2016) are sets that generate *N* denotations under mereological sum, $\sqcup$. These are referred to as 'generator sets' in Landman (2011) and base-sets in Landman (2016) (henceforth we mostly use terminology from Landman (2016)). Landman analyses noun denotations in terms of pairs of sets $\langle \mathbf{body}, \mathbf{base} \rangle$ (an "i-set"). Bodies are the sets that determine truth conditions for predicates. Bases generate bodies under sum. The count/mass status of a noun is determined by overlap or disjointness in the base: For i-set X, "X is count iff $\mathbf{base}(X)$ is disjoint, otherwise X is mass." (Landman, 2016: p. 8).

Of particular interest in the context of this paper, are what Landman calls *neat mass* nouns. Neat mass nouns are, approximately, those nouns otherwise referred to as object mass nouns (*furniture, kitchenware*). Neat mass nouns are mass as per the above definition, but are also neat (as opposed to mess nouns like (*water, meat, salt*): "X is neat iff $\mathbf{min}(\mathbf{base}(X))$ is disjoint and $\mathbf{min}(\mathbf{base}(X))$ generates $\mathbf{base}(X)$ under $\sqcup$, otherwise X is mess." (Landman, 2016: p. 9).

Entities in the base sets for neat mass nouns represent that which intuitively counts as 'one'. For example, the base-set for *kitchenware* would include, *inter alia*, single pestles, mortars, pans, and lids, but also pestle and mortar sums, and pan and lid sums. With such a denotation, *kitchenware* would be neat since e.g. $\mathbf{min}(\mathbf{base}(\textit{KITCHENWARE})) = \{pestle, mortar, pan, lid\}$, a disjoint set. However, *kitchenware* would be mass since e.g. $\mathbf{base}(\textit{KITCHENWARE}) = \{pestle, mortar, pan, lid, pestle \sqcup mortar, pan \sqcup lid\}$, an overlapping set.

The reason Landman emphasizes overlap in base sets is that overlap makes counting go wrong. In Landman's (2011) terminology, variants, V of a set X are maximally disjoint subsets X and

$^*V \subseteq X$ such that $\sqcup X \in {}^*V$. For the above example for *kitchenware*, possible variants would be:

$$\begin{array}{lll|lll} V_1 = & \{mortar, pestle, pan, lid\} & \text{(4 items)} & V_2 = & \{pestle \sqcup mortar, pan, lid\} & \text{(3 items)} \\ V_3 = & \{mortar, pestle, pan \sqcup lid\} & \text{(3 items)} & V_4 = & \{pestle \sqcup mortar, pan \sqcup lid\} & \text{(2 items)} \end{array}$$

The existence of different variants leads to multiple different answers to the question *how many?*, hence counting goes wrong (even if we can count the items in each variant, of course). The connection between Rothstein's (2010) default counting contexts and variants should be relatively transparent (however see Sutton and Filip (2016b) for an in-depth discussion). In our account, we will make use of a similar notion, albeit in the context of kind and subkinds.

2.3. Sutton and Filip (2016a): Mass Ns are saturated will the null counting context

Our analysis of object mass nouns as predicates of entities (Sutton and Filip, 2016a) is, in part, a synthesis of Landman's variants and Rothstein's counting contexts. Counting contexts are indices on interpretations of predicates. We assume a domain of counting contexts $\mathcal{C} = \{c_0, c_1, \ldots, c_n\}$ such that $c_1, \ldots, c_n$ are default counting contexts in the sense of Rothstein (2010), roughly Landman's variants, and c_0 is the null counting context. We define the NULL COUNTING CONTEXT c_0 to model contexts in which overlapping entities in a noun's denotation "can all count as one simultaneously in the same context" (Landman, 2011: pp. 34-5), such that overlap makes counting go wrong. The interpretation of a predicate at the null counting context c_0 is the union of the interpretations of the predicate at all counting contexts (i.e. variants). Examples for specific, disjoint counting contexts and the null, overlapping, counting context are given in Figure 1.

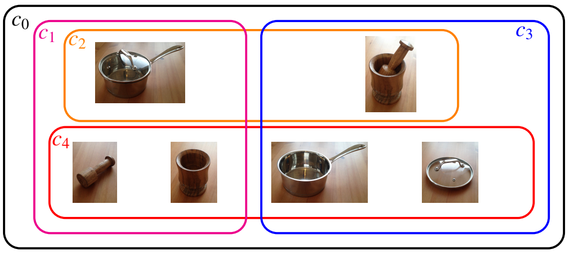

Figure 1: Null counting context c_0 and disjoint counting contexts c_1-c_4

We propose that all concrete nouns contain a context variable in their lexical entries, which means that they are of type $\langle c, \langle e,t\rangle\rangle$. However, the lexical entries of mass nouns are saturated with the null counting context, which β-reduces them to type $\langle e,t\rangle$. For example, the lexical entry for the mass noun *kitchenware* is given in (7). Although uttered in c_i, the entry is saturated with the null counting context c_0.

$$[\![\text{kitchenware}]\!]^{c_i} \quad = \quad \lambda x \langle \text{K\_WARE}(x), \mathbf{IND}(\text{K\_WARE})(c_0)(x)\rangle \tag{7}$$

The null counting context allows for overlap in noun denotations, as c_0 in Figure 1 shows. This makes them grammatically uncountable.

The lexical entries of count nouns are NOT saturated with the null counting context. Instead, the counting context argument is filled by the specific context of use. This has the effect that, when used in a given utterance, their context argument saturated with a particular counting context. So, count nouns also β-reduce to type $\langle e,t\rangle$ in a particular context. For example, the lexical entry for the German count noun *Küchengerät* ('kitchenware', lit. kitchen.device) is given in (7). The expression is uttered and evaluated at c_i.

$$[[\text{Küchengerät}]]^{c_i} \quad = \quad \lambda x\langle \text{K\_WARE}(x), \mathbf{IND}(\text{K\_WARE})(c_i)(x)\rangle \tag{8}$$

Specific counting contexts only determine discrete, non-overlapping objects, as we see in c_1, c_2, c_3, c_4, in Figure 1. If there is any overlap present in the noun's denotation, specific counting contexts will resolve it.

A major strength of this account is that it allows us to easily account for crosslinguistic variation in count/mass lexicalization patterns (as shown in (7) and (8)). The only difference between a mass noun like the English *kitchenware* and a count noun like the German *Küchengerät* ('kitchenware', lit. kitchen.device), is that the IND-set of individuated entities is evaluated at the null counting context c_0 in the first instance and at the counting context of utterance c_i in the second. This results in an overlapping IND-set for *kitchenware* and a disjoint IND-set for *Küchengerät*. This explains why *kitchenware* is mass, but *Küchengerät* is count.

Another advance made in Sutton and Filip (2016a) lies in the explanation of why mass-to-count coercion is blocked for object mass nouns, even if they have 'natural atoms' (ordinary individuals like chairs, tables, in the denotation of *furniture*) in their denotation. That is, we explain why the mass-to-count coercion operation cannot access 'natural atoms' that are available in their denotation.

Our analysis hinges on contrasting the implicit classifier concepts needed in cases of mass-to-count coercion (*three* [PORTIONS OF] *water*) with the role of explicit unit-extracting expressions in e.g. *piece/item of furniture*. We analyse unit-extracting classifier expressions such as *piece of*, *item of* as functions that forcibly insert the counting context of utterance into the interpretation of the whole unit-extracting phrase. In other words, such expressions shift the interpretations of nouns from being indexed at the null context (c_0) with overlapping IND-sets to being indexed to disjoint counting contexts (c_1, c_2, c_3, c_4). The effect on *kitchenware*, for example, is that *item of kitchenware* is interpreted with the same entry as the right hand side of (8), a pair with a disjoint, and so countable, IND-set. Based on these two assumptions, the reason why *#three kitchenwares* cannot be coerced to mean 'three ITEMS OF kitchenware' is that IMPLICITLY provided unit-extracting classifier concepts cannot perform the 'heavy handed' semantic operation of rewriting the null-context as the context of utterance. We must, we argue, evaluate at the null counting context provided by the lexical entry of the object noun, so overlap is not resolved. This blocks grammatical counting for object mass nouns in terms of a cardinality of a particular set of object instances. Counting goes wrong, even if the units for counting are conceptually accessible.

3. A semantics for kind readings of count and mass nouns

In this section, we argue that there are parallels between counting particular individuals and counting kinds (or subkinds). From this parallelism, we are justified in applying much of the basic architecture for analysing predicate readings of count and mass nouns, developed in Sutton and Filip (2016a) to the analysis of kind readings of count and mass nouns.

One parallel between counting particular individuals and counting kinds is that, in both cases, overlap makes counting go wrong. As we saw in Section 2, Landman's (2011; 2016) idea was that counting means non-overlap (or overlap made irrelevant). This main property behind mass/count lexicalization was adopted and built on in Sutton and Filip (2016a). We generalise this from particular individuals to kinds. First, we will argue that object mass nouns have an extensionally overlapping subkind structure, while other mass nouns do not. Then we point out that this tracks the felicity of countable subkinds in coercion environments. Finally, we provide some evidence that extensional overlap on the level of kinds prohibits felicitous counting.

By way of a working example, compare the English mass nouns *furniture* and *rice*. We do not claim that there is, definitively, a single way to analyse the kind-subkind structure of these nouns, however, two possible (partial) representations are given in Figures 2 and 3. Subkinds of **furniture** include categories such as **bedroom furniture**, **living room furniture**, and **dining room furniture**. In turn, subkinds of these categories include basic level category kinds such as **beds**, **chairs**, and **cabinets**. As Figure 2 shows, when we look to the extensional level, such as the extension of the basic level kind **chairs**, there are entities that are chairs that count as **bedroom**, **living room**, and **dining room** furniture. But this means that the subkinds **bedroom**, **living room**, and **dining room** furniture overlap extensionally. This makes sense, given that, for example, chairs labelled as 'bedroom chairs' (say in department store catalogue) can look and function just like chairs labelled 'kitchen chairs' or 'dining room chairs'.

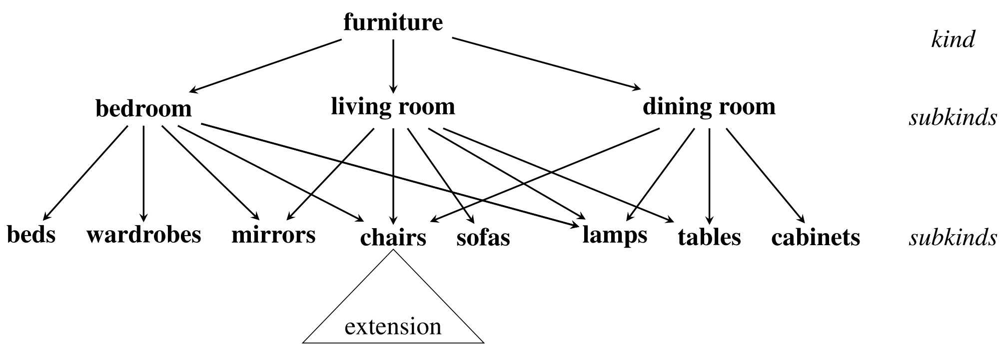

Figure 2: Kind-subkind structure of *furniture*

In contrast, subkinds of **rice** plausibly include categories such as **long grain** and **short grain**. In turn, subkinds of these categories include species kinds such as **jasmine** and **arborio**. Notice, however, that relative to one horizontal level in Figure 3, the subkinds do not overlap.[7] It will be important, as part of our fuller account to say more about the significance of such horizontal levels. We give a more precise characterisation of this in Section 3.1.

[7] It is possible that, as with most natural language expressions, the borderline between categories may be vague. We do not rule out, therefore, that there may be, for example, some rice that is a borderline case between long grain and short grain rice. However, this is distinct from the overlapping case for furniture in which, for example, some chair could be a clear case of both a dining room chair and a bedroom chair. When we use the term 'overlapping' with respect to kinds, we therefore mean 'clearly overlapping' as is the case with the denotation of *furniture*, as opposed to possibly vaguely overlapping, as could be argued for most natural language expressions.

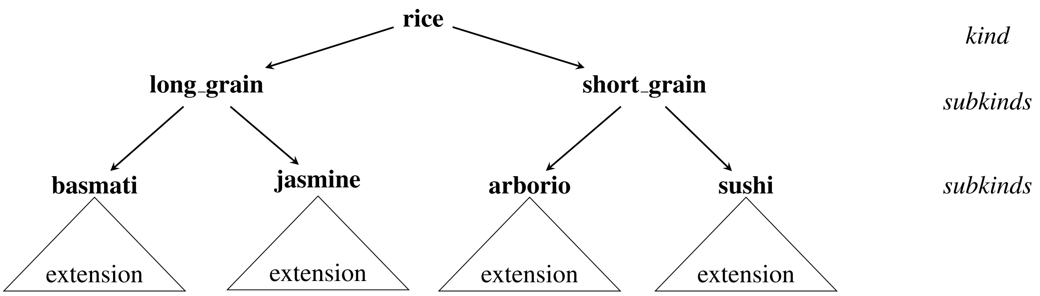

Figure 3: Kind-subkind structure of *rice*

We hypothesise that there are two sources for the kind of overlap we see for *furniture*-like nouns but not for *rice*-like nouns. First, nouns like *rice* form a well-formed biological taxonomy, and, as such form disjoint subkinds. Nouns such as *furniture* do not denote well formed taxonomies.[8] Second, nouns such as *furniture* denote highly heterogeneous collections of artefacts. Members of collective artefact categories like **furniture**, **footwear**, **jewellery** are related through a network of 'family resemblance' style overlapping and criss-crossing relations. Furthermore, their 'vertical' kind-subkind relations are inconsistent with a well-formed taxonomy (inheritance of properties, transitivity, (see e.g., Wierzbicka, 1985; Wisniewski et al., 1996)).

These two properties (ill-formed taxonomies and heterogeneity), together, seem to make the probability of extensional overlap between kinds very high. Furthermore, we have seen from the distinction between *vehicle* and *transport* in (5a) and (5b), that the inaccessibility of countable subkind readings is restricted to a subclass of mass nouns. These factors, taken together, yield the following prediction. If a noun is mass and denotes a collection of homogenous artefacts, then there will be no felicitous mass-to-subkind reading when the noun is directly modified by a numerical expression or is pluralised.

In summary, we have diagnosed some properties that we think give rise to the kind of extensional overlap between kinds that we have described above. We gave some reason to associate overlap with a failure of counting entities in our discussion of (Landman, 2011, 2016): overlap makes counting go wrong because it gives rise to multiple answers to the question 'how many?'. We end this section with some evidence that non-overlap matters for counting kinds.

In English, one can explicitly access subkinds for mass nouns by using kind classifier expressions such as *kind (of)*, *type (of)*, and *sort (of)*. This is useful, because we can see that in cases where there is nonetheless overlap between explicitly referred to subkinds, counting of subkinds is only possible if any overlap is resolved. For example, (9) would be felicitous in cases where two sets of chairs were bought (one for the kitchen, one for the dining room), even if either set of chairs could have been used in the other location.

(9) I ordered two kinds of furniture: kitchen furniture and dining room furniture.

[8] We will address an alternative account proposed by Grimm and Levin (2016) which focuses on the failure of taxonomic properties for artefact denoting nouns in Section 5.1.

That is to say, if we ignore or remove overlap and treat the sets as disjoint, then counting is possible. However, if we make the removal of overlap impossible, we get infelicity in numerical constructions. For example, the truth-conditions of (9) exclude a case where one ordered one set of chairs that could function both as kitchen chairs and dining room chairs.

3.1. Formal account

The main idea to be formally elaborated upon here is that counting subkinds is sensitive to KIND COUNTING CONTEXTS that remove overlap between subkinds in their constituent members. We introduce kind counting contexts as an index in the formalism. However, their precise mechanisms are likely to be dependent on pragmatic speaker-hearer decisions based on intensional criteria. From the set of kind counting contexts, we define a NULL KIND COUNTING CONTEXT. The null counting context does not resolve overlap. Akin to the treatment of mass nouns in Sutton and Filip (2016a), the lexical entries of mass nouns are saturated with the null kind counting context. Count nouns will take the kind counting context of utterance.

We restrict our semantics to kind (or subkind) readings, modelled as Boolean semilatticies closed under sum. Models M are a tuple $M = \langle \mathcal{D}, \mathcal{C}, \mathcal{L} \rangle$:

$\mathcal{D}$ = $\{\mathbb{D}_e, \mathbb{D}_k, \mathbb{D}_t\}$
$\mathbb{D}_e$ = the domain of entities, a semilattice structure of atomic entities closed under $\sqcup_e$.
$\mathbb{D}_k$ = the domain of (sub)kinds, k_i, a semilattice structure of atomic subkinds closed under $\sqcup_k$.
$\mathbb{D}_t$ = $\{0,1\}$
$\mathcal{C}$ = set of counting contexts c_i
$\mathcal{L}$ = set of levels of categorisation l_i

Other formal terminology is as standard except we mark relations between entities with a subscript e and relations between kinds with a subscript k.

$\sqcup_e$	mereological sum for entities	$\sqsubseteq_k$	part of (kinds and subkinds)
$\sqcup_k$	mereological sum for (sub)kinds	$\sqsubset_k$	proper part of (kinds and subkinds)
$\sqsubseteq_e$	part of (entities)	$a : k$	a is of (sub)kind k
$\sqsubset_e$	proper part of (entities)	$k \circ k'$	k overlaps with k'

We do not commit to a particular analysis of kinds, we assume a basic intuitive taxonomic 'kind of' relation. Notably, the mereology of kinds mirrors the mereology of entities. For example, the definition of the part of relation for kinds is *mutatis mutandis* identical to the definition of 'part of' in standard mereology (10). However, subkinds also imply relations between entities of that kind (like subtypes in type theory) as defined in (11). Because we wish to capture overlap between parts of entities as well as whole entities, we adopt Landman's (2016) use of Boolean part sets defined in (12). Extensional overlap between kinds is defined in (13).[9]

[9]We presume this is relative to a world but we suppress such details here.

$$\forall k,k'[k \sqsubseteq_k k' \leftrightarrow k \sqcup_k k' = k'] \tag{10}$$

$$\forall k,k'[k \sqsubseteq_k k' \leftrightarrow \forall x_{\langle e \rangle}[x : k \rightarrow x : k']] \tag{11}$$

$$(x] = \{y \mid y \sqsubseteq_e x\} \tag{12}$$

$$\forall k,k'[k \circ k' \leftrightarrow \exists x,y,z_{\langle e \rangle}[y : k \wedge z : k' \wedge x \in (y] \wedge x \in (z]]] \tag{13}$$

In words, two kinds extensionally overlap if an entity or a proper part of some entity that is in one is an entity or a proper part of an entity in the other.

Levels of categorisation: When it comes to counting subkinds, the requisite resolution of overlap with respect to a counting context amounts to the restriction of not simultaneously counting entities at DIFFERENT LEVELS of categorisation. For example, it is highly marked to say *I bought two kinds of furniture: tables and living room*. We semi-formally define levels of categorisation in the following way.

k,k' are admissible on the same level of categorisation, iff

(i) $\neg(k \sqsubset k')$ and $\neg(k' \sqsubset k)$
(ii) k and k' form part of a natural comparison class of subkinds.

We assume a pre-theoretic notion of *natural comparison class* and give only the examples in Table 1 to demonstrate it. Examples of levels of categorisation for the kinds **rice** and **furniture** are also given in Table 1.

Table 1: Examples of levels of categorisation

Kind	level	subkinds forming a natural comparison class
rice	*colour*	**brown**, **white**
	grain length	**long_grain**, **short_grain**
	origin	**USA**, **India**
furniture	*furnishing space*	**bedroom**, **office**
	item type	**chairs**, **sofas**

Counting contexts: Kind counting contexts, c_i, are mappings from sets of subkinds (at some level) to maximally disjoint sets of subkinds (at that level). For example, there are different EXTENSIONAL RESOLUTIONS of the sub-kinds **dining_room** and **bedroom** furniture. We will call these e.g. $\textbf{dining\_room}_1, ..., \textbf{dining\_room}_n, \textbf{bedroom}_1, ..., \textbf{bedroom}_n$. Extensional resolutions differ, for example, with respect to whether some particular chair counts as dining room furniture or bedroom furniture. In this sense, they are different from *variants* since they have no condition of maximal disjointness or generation of the extension of the full extension under sum. Some of the resolutions from one subkind may overlap with some resolutions from the other, but some of the resolutions from one subkind may be disjoint with some resolutions from the other. Kind counting contexts resolve the overlap inherent in the subkind structure of the kind by selecting non-overlapping extensional resolutions for each subkind in a set of subkinds. Effectively, counting contexts force a choice for specific items in the domain: "Is this dining room furniture or bedroom furniture in this context?"

At the *null counting context* (c_0), subkinds may be overlapping in their constituent members and extensional overlap makes counting of subkinds go wrong. The *null counting context* (c_0) is defined in (14), relative to a counting level, in terms of the union of counting contexts $c_{i\geq 1} \in \mathcal{C}$ (all maximally disjoint subsets of X).

$$X_{c_0,l_i} = \bigcup X_{c_i,l_i} \text{ computed from all } c_{i\geq 1} \in \mathcal{C} \qquad (14)$$

IND$_k$ function: Kind predicates are interpreted relative to levels ($l_i \in \mathcal{L}$) of categorisation and counting contexts ($c_i \in \mathcal{C}$). The intuitive notion of 'counting as one' is here recast as a function IND$_k$. We assume that IND$_k$ is intensional and also dependent on, *inter alia*, the purposes and goals of the communicative agents. For simplicity, we set these complications aside. IND$_k$ accesses the subkind structure of a kind predicate (a set of subkinds $\langle k,t\rangle$) and introduces a counting context argument c, and a counting level argument l. At a context and a level the subkinds in the set count as 'one'. IND$_k$ is of type $\langle k,\langle l,\langle c,\langle k,t\rangle\rangle\rangle\rangle$. Given a kind, a level and a context, it outputs a set of (sub-)kinds that can be counted if they do not overlap extensionally.

$$\text{IND}_k = \lambda k_1 \lambda l \lambda c \lambda k_2[k_2(l)(c) \wedge k_2 \sqsubseteq k_1] \qquad (15)$$

Examples of IND$_k$, counting contexts and levels: In order to solidify how these different parts of our formal apparatus operate, we provide a toy example of how the subkinds structure of *furniture* can be broken down into different levels of categorisation and made disjoint at different counting contexts. Table 2 shows some of the subkinds for *furniture* at two different levels indexed for different extensional resolutions. Table 3 demonstrates how, relative to level l_1, the extensions of the different extensional resolutions can overlap. In this example, there are two elements, c and d, which are in the extension of more than one subkind.

Table 2: Examples of subkinds for *furniture* at two different levels of categorisation, indexed for different extensional resolutions.

Level	Subkinds
l_1	$\textbf{dining\_room}_1,\ldots,\textbf{dining\_room}_n,\textbf{bedroom}_1,\ldots,\textbf{bedroom}_n,\ldots$
l_2	$\textbf{chairs}_1,\ldots,\textbf{chairs}_n,\textbf{tables}_1,\ldots,\textbf{tables}_n,\ldots$

Table 3: Some extensional resolutions for subkinds of *furniture*.

dining_room			**bedroom**		
$\textbf{dining\_room}_1$	$\textbf{dining\_room}_2$	$\textbf{dining\_room}_3$	$\textbf{bedroom}_1$	$\textbf{bedroom}_2$	$\textbf{bedroom}_3$
|	|	|	|	|	|
extension	extension	extension	extension	extension	extension
$\downarrow$	$\downarrow$	$\downarrow$	$\downarrow$	$\downarrow$	$\downarrow$
$\{a,b\}$	$\{a,b,c\}$	$\{a,b,c,d\}$	$\{e,f\}$	$\{d,e,f\}$	$\{c,d,e,f\}$

There are different ways to resolve this overlap by applying kind counting contexts in order to ensure that the extensional resolutions of subkinds are non-overlapping. Three of the possible counting contexts are given in Table 4. At each counting context, one extensional resolution is chosen from each subkind (at a particular level) such that the subkinds are disjoint.

Table 4: Some possible counting contexts for *furniture* at l_1.

Context	Subkind Resolution
c_1	$\{\textbf{dining\_room}_1, \textbf{bedroom}_3\}$
c_2	$\{\textbf{dining\_room}_2, \textbf{bedroom}_2\}$
c_3	$\{\textbf{dining\_room}_3, \textbf{bedroom}_1\}$

Finally, we give an example of how the IND_k function provides the argument structure for levels and counting contexts. The formulas below will form parts of lexical entries of kind readings of nouns. We give details of this in Section 3.2.

$$\text{IND}_k(\textbf{furniture}) = \lambda l \lambda c \lambda k[k(l)(c) \wedge k \sqsubseteq \textbf{furniture}] = \begin{array}{l}\{\textbf{dining\_r}_1, ..., \textbf{dining\_r}_n,\\ \textbf{bedroom}_1, ..., \textbf{bedroom}_n,\\ \textbf{chairs}_1 ..., \textbf{chairs}_n,\\ \textbf{tables}_1 ..., \textbf{tables}_n, \}\end{array}$$

$$\text{IND}_k(\textbf{furniture})(l_1) = \lambda c \lambda k[k(l_1)(c) \wedge k \sqsubseteq \textbf{furniture}] = \begin{array}{l}\{\textbf{dining\_r}_1, ..., \textbf{dining\_r}_n,\\ \textbf{bedroom}_1, ..., \textbf{bedroom}_n\}\end{array}$$

$$\text{IND}_k(\textbf{furniture})(l_1)(c_1) = \lambda k[k(l_1)(c_1) \wedge k \sqsubseteq \textbf{furniture}] = \{\textbf{dining\_r}_1, \textbf{bedroom}_3\}$$

(two non-overlapping subkinds relative to level l_1 & context c_1)

3.2. Lexical entries for kind denoting expressions

We wish to remain neutral with respect to the relationship between kind readings and predicate readings for nouns in English. However, a reasonable working hypothesis is that there is a kind shifting operation from predicates to kinds (generally available for mass nouns, for count nouns, licensed by the bare plural noun morphology or definite article plus singular noun constructions).

Kind readings of nouns are interpreted as pairs $\langle \textbf{kind}, \textbf{counting\_base} \rangle$. The **kind** is the kind for a noun (the result of a kind shifting operation). The **counting_base** is the result of the application of the IND_k function to a kind ($\text{IND}_k(\textbf{n})$). Recall that the IND function for kinds applies to a kind **n** and yields a function from counting levels l to a function from counting contexts c, to a set of subkinds k each of which count as 'one' with respect to the kind **n**. Counting of kinds is licensed only when the counting base does not overlap extensionally. Count nouns are interpreted at the level and counting context of utterance. Mass nouns are interpreted at the level of utterance, but come saturated with the null counting context (c_0). This means that any overlap in the IND-set at a level remains and so can block the counting of subkinds.

Rice: the entry for the mass noun *rice* is given in (16). The first in the pair is the kind **rice**. The second in the pair is the set of subkinds of rice at the level l_j and the null counting context c_0.

$$[\![\text{rice}]\!]^{c_i,l_j} = \langle \mathbf{rice}, \text{IND}_k(\mathbf{rice})(l_j)(c_0)\rangle \tag{16}$$

As Figure 4 helps to show, even at the null counting context, relative to a level, the subkinds of *rice* are extensionally disjoint. This means that they are available for counting. We will give an account of mass-to-subkind coercion in Section 4, however, in principle, this means that directly attaching a numerical expression to *rice* can yield a felicitous subkind reading as in (2b).

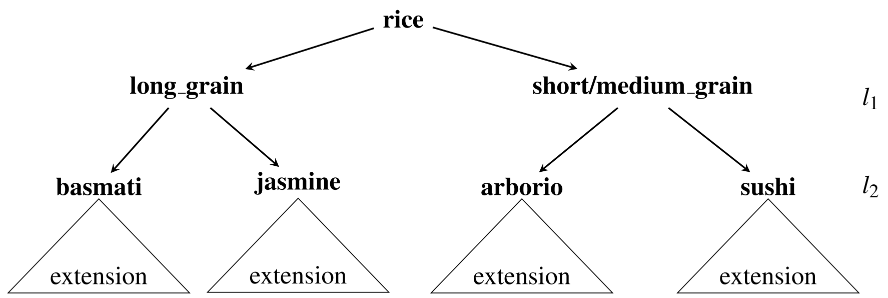

Figure 4: Subkinds at each level have *Disjoint Extensions*

Notice, also, that the subkind structure for *rice* preserves *property inheritance*: the subkind has the same properties as the superkind plus one or more additional properties. For example, Basmati rice is a type of long-grain rice and has the properties of long-grain rice; long-grain rice is a type of rice and has the properties of rice.

Furniture: The lexical entry for the mass noun *furniture* is given in (17) and (18). The only difference between them is how the argument for level of categorisation has been filled.

$$[\![\text{furniture}]\!]^{c_i,l_1} = \langle \mathbf{furniture}, \text{IND}_k(\mathbf{furniture})(l_1)(c_0)\rangle \tag{17}$$

$$[\![\text{furniture}]\!]^{c_i,l_2} = \langle \mathbf{furniture}, \text{IND}_k(\mathbf{furniture})(l_2)(c_0)\rangle \tag{18}$$

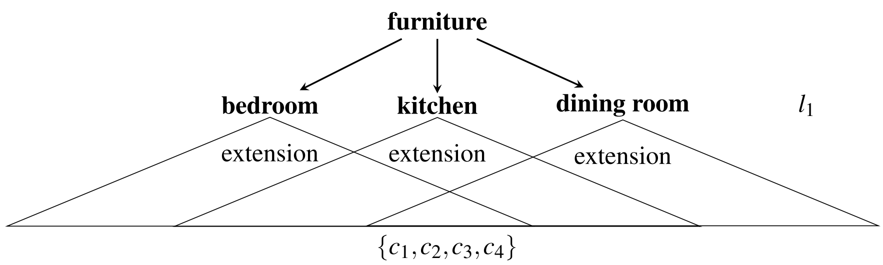

Figure 5: Subkinds at l_1 have *Overlapping Extensions*

Like *rice*, *furniture* is a mass noun and so the entry is saturated with the null counting context. Unlike *rice*, however, the subkinds for *furniture* are not extensionally disjoint at the null counting context at either level as Figures 5 and 6 help to show. At level l_1, for example, some chairs ($\{c_1, c_2, c_3, c_4\}$) count as bedroom, kitchen and dining room furniture. There are, therefore, different answers to the question *how many kinds?* which makes counting of subkinds go wrong. At level l_2, for example, the basic level category **vanities** extensionally overlaps with the basic level categories **chairs**, **tables** and **mirrors**. There are, therefore, different answers to the question *how many kinds?* which makes counting of subkinds go wrong.

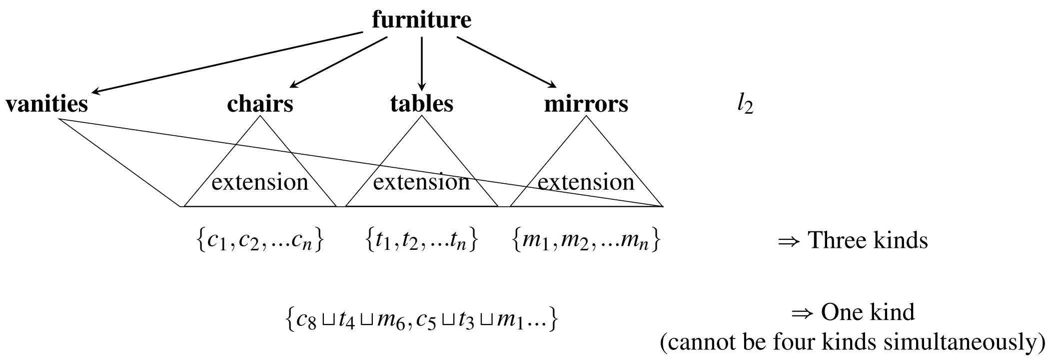

Figure 6: Subkinds at l_2 have *Overlapping Extensions*

Vehicles: The entry for the plural count noun *vehicles* is given in (19). The kind-subkind structure of this collective artefact denoting noun also has overlapping subkinds (just like *furniture*). However, as a count noun, *vehicles* is NOT saturated with the null counting context. Therefore, it is interpreted relative to the counting context of evaluation.

$$[\![\text{ vehicles }]\!]^{c_i, l_2} = \langle \textbf{vehicle}, \text{IND}_k(\textbf{vehicle})(l_2)(c_i) \rangle \tag{19}$$

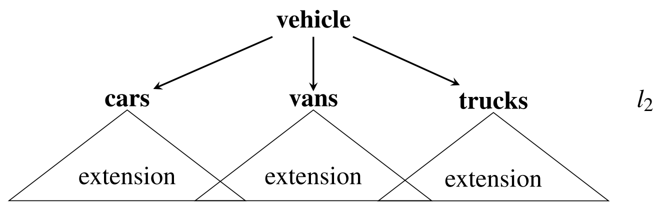

Figure 7: Subkinds at l_2 have *Overlapping Extensions*

That is to say that although the structure of *vehicles* looks just like the structure of *furniture* in terms of overlapping subkinds, because the counting context of evaluation is not the null counting context, extensional overlap between subkinds at each level of categorisation is resolved. Specific counting contexts force the resolution of overlap and so, there is, in any one context, only one answer to the question '*how many kinds?*'. This makes the counting of subkinds possible.

4. Kind extracting expressions and restrictions on subkind coercion

First, in Section 4.1, we give an outline for the semantics of kind extracting classifier expressions such as *kind of*, *type of* and *sort of*. The outcome of this will be a compositional analysis of complex noun expressions such as *kind of furniture*. Our main focus will be on how such expressions compose with lexically simple mass nouns to yield something countable. Second, in Section 4.2 we will provide an analysis of mass-to-subkind cases of coercion. We will show how, combined with or account from Section 3.1, we can explain why coercion is possible for nouns such as *rice* (see example (2b)), but not for collective artefact nouns such *furniture* (see examples (4b) and (4c)).

4.1. Kind extracting expressions

Our account of the kind-subkind structure denoted by concrete nouns allows us to give a very straightforward analysis of kind extracting expressions such as *type of*, and *kind of*. On the assumption that English count nouns are standardly predicate denoting and English mass nouns are standardly kind denoting (Chierchia, 1998), first kind extracting expressions license a type shift to a kind reading for singular count nouns such as *vehicle* in *kind of vehicle* (details of this shifting operation suppressed below). However, more importantly, second, kind extracting expressions force a resolution of any extensional overlap between subkinds at some level of categorisation. Formally, we can represent this as a function that introduces a further context argument into the counting base (we use the standard functions π_i, π_2 such that for an expression $\langle X,Y\rangle_{\langle a\times b\rangle}, \pi_1(\langle X,Y\rangle) = X$ and $\pi_2(\langle X,Y\rangle) = Y$):

$$[\![\text{ n}_{\text{kind reading}}]\!]^{c_i,l_i} = \langle \mathbf{n}, \text{IND}_k(\mathbf{n})(l_i)(c_i)\rangle_{\langle k\times\langle k,t\rangle\rangle} \tag{20}$$

$$[\![\text{ kind of }]\!] = \lambda\mathcal{K}_{\langle k\times\langle k,t\rangle\rangle}\lambda c\langle \pi_1(\mathcal{K}), \pi_2(\mathcal{K})(c)\rangle \tag{21}$$

Since kind counting contexts are mappings from sets of subkinds (at some level) to maximally disjoint sets of subkinds (at that level), counting contexts can be stacked. Applying a specific counting context to an overlapping set of subkinds evaluated at the null counting context, returns a disjoint set of subkinds. For kinds denoted by mass nouns, therefore, the kind extracting expression operation, in effect, replaces the null counting context, c_0, with the counting context of utterance for the kind-extracting expression. This allows the counting of subkinds. For instance, for *kind of furniture* in (22):

$$\begin{aligned}[\![\text{ kind of furniture }]\!]^{c_i,l_j} &= [\![\text{ kind of }]\!]^{c_i}([\![\text{ furniture }]\!]^{c_i,l_j})\\ &= [\![\text{ kind of }]\!]([\![\text{ furniture }]\!]^{c_i,l_j})(c_i)\\ &= \lambda\mathcal{K}.\lambda c.\langle \pi_1(\mathcal{K}), \pi_2(\mathcal{K})(c)\rangle(\langle \mathbf{furn}, \text{IND}_k(\mathbf{furn})(l_j)(c_0)\rangle)(c_i)\\ &= \lambda c.(\langle \mathbf{furn}, \text{IND}_k(\mathbf{furn})(l_j)(c_0)(c)\rangle)(c_i)\\ &= \langle \mathbf{furn}, \text{IND}_k(\mathbf{furn})(l_j)(c_0)(c_i)\rangle\\ &= \langle \mathbf{furn}, \text{IND}_k(\mathbf{furn})(l_j)(c_i)\rangle\end{aligned} \tag{22}$$

The context of evaluation for the kind extracting expression applies to the counting base and enforces the extensional resolution of overlap among subkinds in that context. This prevents multiple, and possibly inconsistent, category assignments to ordinary individuals, e.g., one chair *simultaneously* realising two different subkinds, **kitchen_furniture** and **dining_room_furniture**, for instance, *in the same context at the same time*; of course, one and the same chair can be categorised as a kitchen chair in one context, and a dining room chair in another context.

4.2. Restrictions on subkind coercion

Subkind coercion, we assume, is one possible strategy for resolving a type-mismatch such as the one created by applying a numerical expression directly to a mass noun. One way of attempting to resolve this mismatch is to access the subkind structure in the kind reading of the mass noun's lexical entry and attempt to enumerate these subkinds. However, this strategy can only be successful if the kind interpretation of the noun has a disjoint subkind structure. If it does not, the grammatical counting operation is not defined. For example, for an expression $\mathcal{K}_{\langle k \times \langle k,t \rangle\rangle}$, the type for a kind-interpretation of a noun, applying a numerical expression such as *three*, will have the result shown in (23).

$$[\![\text{ three }]\!](\mathcal{K}) = \begin{cases} \langle \pi_1(\mathcal{K}), |\pi_2(\mathcal{K})| = 3 \rangle & \text{presupposing } \pi_2(\mathcal{K}) \text{ is disjoint} \\ \bot & \text{otherwise} \end{cases} \tag{23}$$

This will give different results for nouns such as *rice* compared to nouns such as *furniture*. Nouns like *rice* have an extensionally disjoint subkind structure at each level of categorisation. Therefore, if one coerces *rice* as a result of direct numerical modification, the felicitous reading will be to enumerate subkinds. This is the reading for sentences such as (2b). Nouns like *furniture* do not have an extensionally disjoint subkind structure at each level of categorisation. Therefore, if one coerces *furniture*, as a result of direct numerical modification, there will not be a felicitous reading that enumerates subkinds. This explains the infelicity of sentences such as (4b) and (4c).

Furthermore, this will give different results for mass nouns such as *transport* compared to count nouns such as *vehicle*. On the assumption that, in English, the pluralisation of count nouns licenses a kind shifting operation (Chierchia, 1998), counting of subkinds is felicitous because, although **vehicle**, like **transport**, has an overlapping subkind structure, the lexical entry for *vehicle* is not, as a count noun entry, saturated with the null counting context whereas the lexical entry for *transport*, as a mass noun entry is saturated with the null counting context. This means that in every context of utterance, the overlap between subkinds for **vehicle** is resolved by the counting context of use. On the other hand, the saturation of the lexicon with the null counting context for *transport* means that extensional overlap between subkinds is not resolved. This explains the felicity of examples such as (5a) and the infelicity of examples such as (5b).

5. Conclusions and comparisons with other accounts

5.1. An alternative account: Grimm and Levin (2016)

As far as we know, there is only one other account (Grimm and Levin, 2016) that tries to accommodate the data we have considered here. Grimm and Levin emphasise that collective artefact (*furniture*-like) nouns and their purported subordinate terms do not stand in a well formed taxonomic relation *viz.* they do not participate in the kind-subkind relations necessary to form a well-formed taxonomy. For example, in well formed taxonomies, subkinds inherit all properties from superkinds. Take the kind **apple**, the subkind **green apple** and the subsubkind **granny smith**. Green apples have all the properties of apples, and Granny Smiths have all the properties of green apples. The inheritance relation is transitive. Collective artefacts do not preserve property inheritance. The reason for this, on Grimm and Levin's (2016) analysis, derives from their claim that denotations of collective artefact nouns include (potential) associated events. For example, part of the lexical semantics of *furniture* is that items in the denotation of *furniture* potentially participate in furnishing events, or at least has the potential to serve this function. This is meant to contrast with expressions such *chair*, the denotata of which participate in sitting-on events. The result is that "$[\![$ chair $]\!] \not\subseteq [\![$ furniture $]\!]$, even though chairs (in stereotypical worlds) always satisfy the associated event of furniture." and"*Furniture*-like nouns and their constituent entities have different associated events, and therefore do not participate in the sub-/super-kind relation necessary to form an artifactual taxonomy." (Grimm and Levin, 2016). To take another example, *furniture* is for furnishing spaces and mirrors are a subkind of furniture, however, mirrors are not all for furnishing spaces. Compact make-up mirrors and telescope mirrors, for instance, do not share this function.

We have made no mention, in our account, of associated events, but we do not see any reason why there should not be an event-related component in the analysis of kinds denoted by artefact nouns. It strikes us as plausible that, if events are a part of the lexical semantics for artefact denoting nouns, then reference to event types may well underspecify extensions in a way that will give rise to extensional overlap in subkinds. In this sense, our account and Grimm and Levin's may well be compatible. Further work must be done to establish the veracity of this possibility, however.

5.2. Conclusions

The crucial difference between *furniture*- and *rice*-like nouns, on our account, is that subkinds of *furniture*-like nouns extensionally overlap with respect to their constituent subordinate entities, i.e., 'lower' subkinds and ordinary individuals. *Furniture*-like nouns do not lack subkinds entirely (*pace* Grimm and Levin (2016)), but their taxonomies are defective, and so inconsistent with well-formed taxonomies. This is not the case for prototypical mass nouns like *water* or granular nouns like *rice*, which have taxonomic subkinds whose members we view as conceptually not overlapping.

The crucial difference between *furniture*- and *vehicle*-like nouns, on our account, is that, as mass nouns, *furniture*-like nouns are indexed to the null counting context (c_0) whereas count nouns like *vehicle* are indexed to the counting context of utterance. This means that when interpreted with kind readings, despite the fact that both kinds of nouns denote extensionally overlapping subkind structures, the subkinds of *vehicle*-like nouns are countable because the counting context of utterance forces a choice which resolves this overlap. In context, we are forced to decide if some vehicles are trucks or vans. The result of this choice determines whether there are two kinds of vehicles or just one.

The indexing of mass nouns to the null counting context explains why a simple 'kind of' coercion is insufficient for object mass nouns: they have overlapping taxonomic (sub)kinds. The coercion operation consists of accessing, and attempting to enumerate, the subkind structure in the lexical entry. Counting subkinds is only then possible if the subkinds at some level are extensionally disjoint. This contrasts with the explicit use of a kind extracting expression such as *kind of* which also provides a counting context of utterance that resolves extensional overlap.

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Bounded rationality and logic for epistemic modals[1]

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Abstract. Kratzer (1991) provides *comparative epistemic modals* such as '*at least as likely as*' with their models in terms of a *qualitative ordering*. Yalcin (2010) shows that Kratzer's model does *not validate* some intuitively *valid* inference schemata and *validates* some intuitively *invalid* ones. He adopts a model based directly on a *probability measure* for comparative epistemic modals. His model does *not* cause this problem. However, as Kratzer (2012) says, Yalcin's model seems to be *unnatural* as a model for comparative epistemic modals. Holliday and Icard (2013) prove that not only a *probability measure model* but also a *qualitatively additive measure model* and a *revised version of Kratzer's model* do not cause Yalcin's problem. Suzuki (2013) proposes a logic the model of which reflects Kratzer's intuition above, does not cause Yalcin's problem, and has *no limitation of the size* of the domain. In the models of Holliday and Icard (2013) and Suzuki (2013), the *transitivity* of probabilistic indifference is valid. The transitivity of probabilistic indifference can lead to a *sorites paradox*. The *nontransitivity* of probabilistic indifference can be regarded as a manifestation of *bounded rationality*. The *aim* of this paper is to propose a new version of *complete* logic—Ḃoundedly-Rational L̇ogic for Ėpistemic Modals (BLE)—the model of the language of which has the following *three* merits: (1) The model reflects *Kratzer's intuition* above in the sense that the model should not be based directly on probability measures, but based on qualitative probability orderings. (2) The model does not cause *Yalcin's problem*. (3) The model is *boundedly-rational* in the sense that the transitivity of probabilistic indifference is not valid. So it does not invite the *sorites paradox*.

Keywords: bounded rationality, epistemic modal, just noticeable difference, modal logic, representation theorem, semiordered qualitative probability, sorites paradox

1. Motivation

Kratzer (1991) provides *comparative epistemic modals* such as '*at least as likely as*' with their models in terms of a *qualitative ordering* on propositions derived from a qualitative ordering on possible worlds. Yalcin (2010) shows that Kratzer's model does *not validate* some intuitively *valid* inference schemata and *validates* some intuitively *invalid* ones. He adopts a model based directly on a *probability measure* for comparative epistemic modals. His model does *not* cause this problem. However, as Kratzer (2012) says, 'Our semantic knowledge alone does not give us the *precise quantitative notions of probability and desirability* that mathematicians and scientists work with', Yalcin's model seems to be *unnatural* as a model for comparative epistemic modals. Holliday and Icard (2013) prove that not only a *probability measure model* but also a *qualitatively additive measure model* and a *revised version of Kratzer's model* do not cause Yalcin's problem. Suzuki (2013) proposes a logic the model of which reflects Kratzer's intuition above, does not cause Yalcin's problem, and has *no limitation of the size* of the domain.

Generally, the standard models of social sciences are based on *global rationality* that requires

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an *optimising behavior*. But according to Simon (1982a, b, 1997), cognitive and information-processing constrains on the capabilities of agents, together with the complexity of their environment, render an optimising behavior an *unattainable ideal*. Simon dismisses the idea that agents should exhibit global rationality and suggests that they in fact exhibit *bounded rationality* that allows a *satisficing behavior*. If an agent has only a *limited* ability of discrimination, he may be considered to be only *boundedly rational*. In the models of Holliday and Icard (2013) and Suzuki (2013), the *transitivity* of probabilistic indifference is valid. The following example shows that the transitivity of probabilistic indifference can lead to a *sorites paradox*:

Example 1 (Sorites Paradox) *Suppose that a prep-school has 1000 candidates, and that a staff member of the school arranges them in order of the average of examination results:* $c_1(top), c_2, \ldots, c_{1000}(bottom)$*, and that, for any* $i (1 \leq i \leq 999)$*,* c_i *will pass the university entrance exam* as likely as c_{i+1} *for him, and that* c_1 *will pass it by far* more likely than c_{1000} *for him. Then if* probabilistic indifference *were* transitive*,* c_1 *would result in passing it* as likely as c_{1000} *for the staff member.*

The *nontransitivity* of probabilistic indifference can be regarded as a manifestation of *bounded rationality*. An agent has only a limited ability of discrimination. The psychophysicist Fechner (1860) explains this limited ability by the concept of a *threshold of discrimination*, that is, *just noticeable difference* (*JND*). Given a measure function f that an examiner could assign to a boundedly rational examinee for an object a, its JND δ is the *lowest intensity increment* such that $f(a) + \delta$ is recognized to be higher than $f(a)$ by the examinee. We can consider a JND from a *probabilistic* point of view. Domotor and Stelzer (1971) introduce the concept of *semiordered qualitative probability* that can provide a qualitatively probabilistic counterpart of a JND.

The *aim* of this paper is to propose a new version of *complete* logic—Ḃoundedly-Rational L̇ogic for Ėpistemic Modals (BLE)—the model of the language of which has the following *three* merits:

1. The model reflects *Kratzer's intuition* above in the sense that the model should not be based directly on probability measures, but based on qualitative probability orderings.

2. The model does not cause *Yalcin's problem*.

3. The model is *boundedly-rational* in the sense that transitivity of probabilistic indifference is not valid. So it does not invite the *sorites paradox* in Example 1.

The structure of this paper is as follows. In Section 2, we show a representation theorem by Domotor and Stelzer (1971) related to a normalized JND. In Subsection 3.1, we define the language $\mathscr{L}_{\mathsf{BLE}}$ of BLE. In Subsection 3.2, we define a structured model $\mathfrak{M}$ of $\mathscr{L}_{\mathsf{BLE}}$, provide BLE with a truth definition at $w \in W$ in $\mathfrak{M}$, define the truth in $\mathfrak{M}$, define validity, provide BLE with some truth conditions in terms of a probability measure, justify the (in)validity of Yalcin's formulae in BLE, and show the invalidity of the transitivity of probabilistic indifference in BLE. In Subsection 3.3, we provide BLE with its proof system. In Subsection 3.4, we show the soundness and completeness theorems of BLE. In Section 4, we finish with brief concluding remarks.

2. Representation theorem for $\succ$

Domotor and Stelzer (1971) prove the following theorem in which δ is interpreted to mean a *normalized JND*:

Theorem 1 (Representation Theorem for $\succ$, Domotor and Stelzer (1971)) *Suppose that W is a nonempty* finite *set of possible worlds, and that $\mathscr{F}$ is the Boolean algebra of subsets of W, and that $\succ$ is a binary relation on $\mathscr{F}$. Then there exists a finitely additive probability measure $P : \mathscr{F} \to \mathbb{R}$ and $\delta \in \mathbb{R}$ satisfying*

$$A \succ B \textit{ iff } P(A) \geq P(B) + \delta,$$

where $0 < \delta \leq 1$ iff the following conditions are met:

1. ***Nontriviality**: $W \succ \emptyset$.*

2. ***Irreflexivity**: Not $(A \succ A)$, for any $A \in \mathscr{F}$.*

3. ***Dominance**: For any $A, B, C \in \mathscr{F}$, if $A \subseteq B$, then if $C \succ B$, then $C \succ A$.*

4. ***Semi-Scottness**: For any $n \geq 1$ and any $A_1, \ldots, A_n, B_1, \ldots, B_n, C_1, \ldots, C_n, D_1, \ldots, D_n \in \mathscr{F}$, if for any $i < n$, $(A_i \succ B_i$ and not $(C_i \succ D_i))$, then if $A_n \succ B_n$, then $C_n \succ D_n$, given that*

$$\bigcup_{1 \leq i_1 < \cdots < i_k \leq n} ((A_{i_1} \cup D_{i_1}) \cap \cdots \cap (A_{i_k} \cup D_{i_k})) = \bigcup_{1 \leq i_1 < \cdots < i_k \leq n} ((B_{i_1} \cup C_{i_1}) \cap \cdots \cap (B_{i_k} \cup C_{i_k}))$$

   holds for any k with $1 \leq k \leq n$.

Remark 1 (Semi-Scottness) *Intuitively, the part after 'given that' of* Semi-Scottness *means that for any $w \in W$, w is in exactly as many $A_i \cup D_i$'s as $B_i \cup C_i$'s.*

3. Boundedly-rational Logic for Epistemic Modals (BLE)

3.1. Language

We define the language $\mathscr{L}_{\mathsf{BLE}}$ of BLE as follows:

Definition 1 (Language) *Let $\mathscr{S}$ denote a set of sentential variables, $\Box$ a unary sentential operator, and $>$ a binary sentential operator. The language $\mathscr{L}_{\mathsf{BLE}}$ of* BLE *is given by the following BNF grammar:*

$$\varphi ::= s \mid \top \mid \neg\varphi \mid (\varphi \wedge \varphi) \mid (\varphi > \varphi) \mid \Box\varphi$$

such that $s \in \mathscr{S}$.

- *$\bot, \vee, \to$ and $\leftrightarrow$ are introduced by the standard definitions.*
- *$\varphi > \psi$ is interpreted to mean that φ is* more likely than ψ.
- $\varphi \geqslant \psi := \neg(\psi > \varphi)$.
- *$\varphi \geqslant \psi$ is interpreted to mean that φ is* at least as likely as ψ.
- $\varphi \approx \psi := \neg(\varphi > \psi) \wedge \neg(\psi > \varphi)$.
- *$\varphi \approx \psi$ is interpreted to mean that φ is* as likely as ψ.
- $\triangle\varphi := \varphi > \neg\varphi$.
- *$\triangle\varphi$ is interpreted to mean that* probably φ.
- *$\Box\varphi$ is interpreted to mean that* it must be that φ.
- $\Diamond\varphi := \neg\Box\neg\varphi$.
- *$\Diamond\varphi$ is interpreted to mean that* it might be that φ.

3.2. Semantics

We define a *structured model* $\mathfrak{M}$ of $\mathscr{L}_{\mathsf{BLE}}$ as follows:

Definition 2 (Model) *$\mathfrak{M}$ is a quadruple (W, R, ρ, V) in which*

- *W is a non-empty set of possible worlds,*
- *R is a binary epistemic accessibility relation on W,*
- *ρ is a* finitely additive semiordered qualitative probability space assignment *that assigns to each $w \in W$ a finitely additive semiordered qualitative probability space $(W_w, \mathscr{F}_w, \succ_w)$ in which*
  - $W_w := \{w' \in W : R(w, w')\}$,
  - *$\mathscr{F}_w$ is the Boolean algebra of subsets of W_w with $\emptyset$ as zero element and W_w as unit element, and*
  - *$\succ_w$ is a finitely additive semiordered qualitative probability ordering relative to $w \in W$ on $\mathscr{F}_w$ that satisfies all of* Nontriviality*,* Irreflexivity*,* Dominance*, and* Semi-Scottness *of Theorem 1, and*

- *V is a truth assignment to each $s \in \mathscr{S}$ for each $w \in W$.*

We provide BLE with the following truth definition at $w \in W$ in $\mathfrak{M}$, define the truth in $\mathfrak{M}$, and then define validity as follows:

Definition 3 (Truth and Validity) *The notion of $\varphi \in \Phi_{\mathscr{L}_{\mathsf{BLE}}}$ being true at $w \in W$ in $\mathfrak{M}$, in symbols $(\mathfrak{M}, w) \models_{\mathscr{L}_{\mathsf{BLE}}} \varphi$, is inductively defined as follows:*

- $(\mathfrak{M}, w) \models_{\mathscr{L}_{\mathsf{BLE}}} s$ *iff* $V(w)(s) = \text{true}$.
- $(\mathfrak{M}, w) \models_{\mathscr{L}_{\mathsf{BLE}}} \top$.
- $(\mathfrak{M}, w) \models_{\mathscr{L}_{\mathsf{BLE}}} \neg\varphi$ *iff* $(\mathfrak{M}, w) \not\models_{\mathscr{L}_{\mathsf{BLE}}} \varphi$.
- $(\mathfrak{M}, w) \models_{\mathscr{L}_{\mathsf{BLE}}} \varphi \wedge \psi$ *iff* $(\mathfrak{M}, w) \models_{\mathscr{L}_{\mathsf{BLE}}} \varphi$ *and* $(\mathfrak{M}, w) \models_{\mathscr{L}_{\mathsf{BLE}}} \psi$.
- $(\mathfrak{M}, w) \models_{\mathscr{L}_{\mathsf{BLE}}} \varphi > \psi$ *iff* $[\![\varphi]\!]_w^{\mathfrak{M}} \succ_w [\![\psi]\!]_w^{\mathfrak{M}}$, *where* $[\![\varphi]\!]_w^{\mathfrak{M}} := \{w' \in W_w : (\mathfrak{M}, w') \models_{\mathscr{L}_{\mathsf{BLE}}} \varphi\}$.
- $(\mathfrak{M}, w) \models_{\mathscr{L}_{\mathsf{BLE}}} \Box\varphi$ *iff for any w' such that $R(w, w')$,* $(\mathfrak{M}, w') \models_{\mathscr{L}_{\mathsf{BLE}}} \varphi$.

If $(\mathfrak{M}, w) \models_{\mathscr{L}_{\mathsf{BLE}}} \varphi$ for any $w \in W$, we write $\mathfrak{M} \models_{\mathscr{L}_{\mathsf{BLE}}} \varphi$ and say that φ is true in $\mathfrak{M}$. If φ is true in all models of $\mathscr{L}_{\mathsf{BLE}}$, we write $\models_{\mathscr{L}_{\mathsf{BLE}}} \varphi$ and say that φ is valid.

The next corollary follows from Definitions 1 and 3.

Corollary 1 (Truth Condition of $\varphi \approx \psi$ and Truth Condition of $\triangle\varphi$)

- $(\mathfrak{M}, w) \models_{\mathscr{L}_{\mathsf{BLE}}} \varphi \approx \psi$ *iff* $[\![\varphi]\!]_w^{\mathfrak{M}} \sim_w [\![\psi]\!]_w^{\mathfrak{M}}$, *where* $[\![\varphi]\!]_w^{\mathfrak{M}} \sim_w [\![\psi]\!]_w^{\mathfrak{M}} :=$ *not* $([\![\varphi]\!]_w^{\mathfrak{M}} \succ_w [\![\psi]\!]_w^{\mathfrak{M}})$ *and not* $([\![\psi]\!]_w^{\mathfrak{M}} \succ_w [\![\varphi]\!]_w^{\mathfrak{M}})$.
- $(\mathfrak{M}, w) \models_{\mathscr{L}_{\mathsf{BLE}}} \triangle\varphi$ *iff* $[\![\varphi]\!]_w^{\mathfrak{M}} \succ_w \overline{[\![\varphi]\!]_w^{\mathfrak{M}}}$.

Then the next corollary follows from Theorem 1 and Corollary 1.

Corollary 2 (Truth Conditions by Probability Measure) *For any $w \in W$, there exists $P_w : \mathscr{F} \to \mathbb{R}$ and such δ that $0 < \delta \leq 1$ satisfying*

- $(\mathfrak{M}, w) \models_{\mathscr{L}_{\mathsf{BLE}}} \varphi > \psi$ *iff* $P_w([\![\varphi]\!]_w^{\mathfrak{M}}) \geq P_w([\![\psi]\!]_w^{\mathfrak{M}}) + \delta$.
- $(\mathfrak{M}, w) \models_{\mathscr{L}_{\mathsf{BLE}}} \varphi \approx \psi$ *iff* $P_w([\![\psi]\!]_w^{\mathfrak{M}}) - \delta < P_w([\![\varphi]\!]_w^{\mathfrak{M}}) < P_w([\![\psi]\!]_w^{\mathfrak{M}}) + \delta$.
- $(\mathfrak{M}, w) \models_{\mathscr{L}_{\mathsf{BLE}}} \triangle\varphi$ *iff* $P_w([\![\varphi]\!]_w^{\mathfrak{M}}) \geq \dfrac{1+\delta}{2}$.

Remark 2 (Logic of Inexact Knowledge) *In* BLE *the truth clause of the epistemic necessity* *operator $\Box$ is not based on a semiordered qualitative probability ordering. In* BLE *the truth clause of $\Box\varphi$ is given in Definition 3 as follows:*

$$(\mathfrak{M},w) \models_{\mathscr{L}_{\mathsf{BLE}}} \Box\varphi \quad \textit{iff,} \quad \textit{for any } w' \textit{ such that } R(w,w'), \quad (\mathfrak{M},w') \models_{\mathscr{L}_{\mathsf{BLE}}} \varphi.$$

*On the other hand, Suzuki (2016) proposes a new version of complete logic—Ḷogic of İnexact K̇nowledge (*LIK*)—the model of the language of which can reflect Williamson (1994)'s arguments on inexact knowledge in the sense that the truth condition of the knowledge operator K ($K\varphi := \varphi \approx \top$) is given in terms of a semiordered qualitative probability ordering as follows:*

$$(\mathfrak{M},w) \models_{\mathscr{L}_{\mathsf{LIK}}} K\varphi \quad \textit{iff} \quad [\![\varphi]\!]^{\mathfrak{M}} \sim_w W.$$

So, by virtue of Theorem 1, for any $w \in W$, there exists $P_w : \mathscr{F} \to \mathbb{R}$ and such δ that $0 < \delta \leq 1$ satisfying

$$(\mathfrak{M},w) \models_{\mathscr{L}_{\mathsf{LIK}}} K\varphi \quad \textit{iff} \quad 1 - \delta < P_w([\![\varphi]\!]^{\mathfrak{M}}) \leq 1.$$

We can also construct BLE *on the basis of this idea.*

Yalcin (2010) presents the following list of *intuitively valid* formulae (V1)–(V11) and *intuitively invalid* formulae (I1) and (I2):

- (V1) $\triangle\varphi \to \neg\triangle\neg\varphi$.

  (If probably φ, then it is not probable that not φ.).

- (V2) $\triangle(\varphi \wedge \psi) \to (\triangle\varphi \wedge \triangle\psi)$.

  (If probably (φ and ψ), then (probably φ and probably ψ).)

- (V3) $\triangle\varphi \to \triangle(\varphi \vee \psi)$.

  (If probably φ, then probably (φ or ψ).)

- (V4) $\varphi \geqslant \bot$.

  (φ is at least as likely as $\bot$.)

- (V5) $\top \geqslant \varphi$.

  ($\top$ is at least as likely as φ.)

- (V6) $\Box\varphi \to \triangle\varphi$.

  (If it must be that φ, then probably φ.)

- (V7) $\triangle\varphi \to \Diamond\varphi$.

  (If probably φ, then it might be that φ.)

- (V8) $(\varphi \to \psi) \to (\triangle\varphi \to \triangle\psi)$.

  (If (if φ, then ψ), then (if probably φ, then probably ψ).)

- (V9) $(\varphi \to \psi) \to (\neg\triangle\psi \to \neg\triangle\varphi)$.

  (If (if φ, then ψ), then (if it is not probable that ψ, then it is not probable that φ).)

- (V10) $(\varphi \to \psi) \to (\psi \geqslant \varphi)$.

  (If (if φ, then ψ), then (ψ is at least as likely as φ).)

- (V11) $(\psi \geqslant \varphi) \to (\triangle\varphi \to \triangle\psi)$.

  (If (ψ is at least as likely as φ), then (if probably φ, then probably ψ).)

- (V12) $(\psi \geqslant \varphi) \to ((\varphi \geqslant \neg\varphi) \to (\psi \geqslant \neg\psi))$.

  (If (ψ is at least as likely as φ), then (if (φ is at least as likely as not φ), then (ψ is at least as likely as not ψ)).)

- (I1) $((\varphi \geqslant \psi) \wedge (\varphi \geqslant \chi)) \to (\varphi \geqslant (\psi \vee \chi))$.

  (If ((φ is at least as likely as ψ) and (φ is at least as likely as χ)), then (φ is at least as likely as (ψ or χ)).)

- (I2) $(\varphi \approx \neg\varphi) \to (\varphi \geqslant \psi)$.

  (If (φ is as likely as not φ), then (φ is at least as likely as ψ).)

We justify the (in)validity of Yalcin's formulae in BLE as follows:

Proposition 1 (Justification of Yalcin's Formulae) BLE *validates all of (V1)–(V12) and validate neither (I1) nor (I2).*

Moreover, in BLE, the transitivity of probabilistic indifference is not valid:

Proposition 2 (Invalidity of Transitivity of Probabilistic Indifference)

$\not\models_{\mathscr{L}_{\mathsf{BLE}}} ((\varphi \approx \psi) \wedge (\psi \approx \chi)) \to (\varphi \approx \chi)$.

So the *sorites paradox* in Example 1 does not appear in BLE.

3.3. Syntax

The proof system of BLE consists of the following:

Definition 4 (Proof System)

Axioms

- *All tautologies of classical sentential logic,*
- $\Box(\varphi \to \psi) \to (\Box\varphi \to \Box\psi)$ *(K),*
- $(\Box(\varphi_1 \leftrightarrow \varphi_2) \wedge \Box(\psi_1 \leftrightarrow \psi_2)) \to ((\varphi_1 > \psi_1) \leftrightarrow (\varphi_2 > \psi_2))$
  (Replacement of Known Equivalents on $>$*),*
- $\top > \bot$ *(Syntactic Counterpart of* ***Nontriviality****),*
- $\neg(\varphi > \varphi)$ *(Syntactic Counterpart of* ***Irreflexivity****), and*
- $$\left(\bigvee_{1 \le i_1 < \cdots < i_k \le n} ((\varphi_{i_1} \vee \tau_{i_1}) \wedge \cdots \wedge (\varphi_{i_k} \vee \tau_{i_k})) \leftrightarrow \bigvee_{1 \le i_1 < \cdots < i_k \le n} ((\psi_{i_1} \vee \chi_{i_1}) \wedge \cdots \wedge (\psi_{i_k} \vee \chi_{i_k}))\right) \to \left(\bigwedge_{i=1}^{n-1} ((\varphi_i > \psi_i) \wedge \neg(\chi_i > \tau_i)) \to ((\varphi_n > \psi_n) \to (\chi_n > \tau_n))\right),$$
  for any $n \ge 1$ *and any* k *with* $1 \le k \le n$

  (Syntactic Counterpart of ***Semi-Scottness****).*

Inference Rules

- $\dfrac{\varphi \to \psi}{(\chi > \psi) \to (\chi > \varphi)}$ *(Syntactic Counterpart of* ***Dominance****),*
- *Modus Ponens, and*
- *Necessitation.*

A proof of $\varphi \in \Phi_{\mathscr{L}_{\mathsf{BLE}}}$ *is a finite sequence of* $\mathscr{L}_{\mathsf{BLE}}$*-formulae having* φ *as the last formula such that either each formula is an instance of an axiom or it can be obtained from formulae that appear earlier in the sequence by applying an inference rule. If there is a proof of* φ*, we write*

$\vdash_{\mathsf{BLE}} \varphi$.

Remark 3 (Infinite Schema) *The syntactic counterpart of Semi-Scottness is an* infinite schema *of axioms for any $n \geq 1$ and any k with $1 \leq k \leq n$.*

3.4. Metalogic

On the basis of Segerberg (1971) and Gärdenfors (1975), we can prove the soundness and completeness theorems of BLE:

Theorem 2 (Soundness) *For any $\varphi \in \Phi_{\mathscr{L}_{\mathsf{BLE}}}$, if $\vdash_{\mathsf{BLE}} \varphi$, then $\models_{\mathscr{L}_{\mathsf{BLE}}} \varphi$.*

Theorem 3 (Completeness) *For any $\varphi \in \Phi_{\mathscr{L}_{\mathsf{BLE}}}$, if $\models_{\mathscr{L}_{\mathsf{BLE}}} \varphi$, then $\vdash_{\mathsf{BLE}} \varphi$.*

4. Concluding Remarks

In this paper, we have proposed a new version of *complete* logic—Ḃoundedly-Rational L̇ogic for Ėpistemic Modals (BLE)—the model of the language of which has the following *three* merits:

1. The model reflects *Kratzer's intuition* above in the sense that the model is not based directly on probability measures, but based on qualitative probability orderings.

2. The model does not cause *Yalcin's problem*.

3. The model is *boundedly-rational* in the sense that the transitivity of probabilistic indifference is not valid. So it does not invite the *sorites paradox* in Example 1.

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Positive vs. negative inversion exclamatives[1]

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Abstract. Not all exclamatives intensify in the same way. In this paper, I examine the semantics of positive inversion exclamatives (e.g., *boy, is he an idiot!*) and negative inversion exclamatives (e.g., *isn't he an idiot!*) in English, and propose that the source of the strengthened meaning is distinct in each construction. The difference, moreover, is derivable from each sibling's question counterpart. I therefore adopt the exclamatives-as-questions approach in my analysis, although I abandon domain widening as the mechanism responsible for their out-of-the-norm meaning. I analyze inversion exclamatives as self-answered polar questions. In the positive variant, the sentence-initial particle *boy* provides the pure "extreme degree" reading canonically associated with exclamatives. Negative inversion exclamatives owe their intensity to the polarity emphasizer VERUM, which is inherited from negative polar questions. At a broader level, the similarities and differences between positive inversion exclamatives, negative inversion exclamatives, and their question counterparts highlight a basic question of form and meaning with respect to sentencial classes — what are exclamatives, are they questions, and what do they do? The convergence sheds light on what "exclamatives" as a natural class are, and the divergence tells a story of the diverse ways in which language can encode intensity.

Keywords: exclamatives, inversion exclamatives, polar questions, intensification, degrees, verum.

1. Introduction

This paper concerns the semantics of two types of inversion exclamatives in English: positive inversion exclamatives (Pos-Ex) and negative inversion exclamatives (Neg-Ex), both exemplified below.

(1) Boy, is Misty grumpy! (positive inversion exclamative)

(2) Isn't Misty grumpy! (negative inversion exclamative)

What makes (1) and (2) exclamative constructions is that they both somehow intensify *grumpy*, the predicate at hand. This intensity is often modeled as *degree* intensification in the literature; that is, (1) and (2) both mean 'Misty is very grumpy.' I argue that this is not the case. While Pos-Ex's genuinely have a degree interpretation, Neg-Ex's involve *epistemic* intensification in which the truth of a proposition is emphasized. I propose that the semantics of inversion exclamatives derive from inversion questions, which naturally accounts for the subtly different behavior of the positive vs. negative siblings.

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§2 will outline empirical observations about positive and negative inversion exclamatives, focusing on how they differ. §3 gives an overview of the existing accounts of exclamatives, and why they do not extend straightforwardly to the present phenomena. §4 elaborates on the tools necessary to analyze inversion exclamatives, such as the semantics of polar questions. My analysis will be presented in §5, and §6 provides a discussion for potential future work.

2. Data

2.1. Positive inversion exclamatives

The form of Pos-Ex's resemble their question counterpart, positive inversion questions (polar questions); the resemblance is highlighted in (3).

(3) a. Boy, is Ash immature! (positive inversion exclamative)
b. Is Ash immature? (positive inversion question)

True polar questions have rising intonation, but Pos-Ex's have a falling intonation. That Pos-Ex's are not information-seeking can further be shown by their lack of answerability, as in (4). True questions can of course be answered as in (5).

(4) A: Boy, is Ash immature!
B: ?? Ash is immature.

(5) A: Is Ash immature?
B: Ash is immature.

One property of Pos-Ex's is that they are only compatible with gradable predicates, that is, predicates with inherent scales associated with them:

(6) a. Boy, is she { whiny / a genius / an idiot / a Pokémon fan }!
b. ?? Wow, is that { a teacher / a salad / a raspberry / dead }!

Note that the pre-sentential particle *boy* and the like are obligatory. As (7) shows, the exclamative is highly degraded without some sort of particle preceding it.

(7) a. Boy/man/damn/wow/god do you run fast!
b. ?? Do you run fast!

As a spoiler alert, the particle will be directly responsible for the facts in (6). But first, let us contrast the Pos-Ex data with Neg-Ex's.

2.2. Negative inversion exclamatives

Like Pos-Ex's, Neg-Ex's have a question counterpart, which I will call negative inversion questions (also called biased polar questions). The two are identical on the surface (8a-b), except for intonation (sentence-final fall for the exclamative, rise for the question).

(8) a. Isn't Ash immature! (negative inversion exclamative)
b. Isn't Ash immature? (negative inversion question)

The falling intonation on Neg-Ex's is accompanied by prosodic focus on the subject (i.e., *isn't* $[Ash]_F$ *immature!*) (Taniguchi, 2016). Readers should keep this intonation in mind in order to block the irrelevant question interpretation in the examples that follow.

Like Pos-Ex's, Neg-Ex's are compatible with gradable predicates:

(9) Isn't she { whiny / a genius / a Pokémon fan }

Non-gradable predicates, however, have a peculiar status with Neg-Ex's. They are acceptable in most cases, as long as a *pejorative* reading can be construed from the predicate. The nuance is a subtle but a consistent one. In (10a) for example, the meaning of the exclamative is that she is *over*-teacherly. Similarly in (10b), being a linguist is taken to be a bad thing.

(10) a. Isn't she a teacher! (...she's constantly telling people facts and quizzing them afterwards!)
b. Isn't he a linguist! (...he's always asking for grammaticality judgments, even during faculty meetings!)

It should be noted that there is also a "motherese" reading of Neg-Ex's: we can imagine (10a-b) being used in reference to a child acting like a teacher or a linguist (the interjection *aww* may help bring out this interpretation). This interpretation is not an insult *per se*, but nevertheless has a demeaning quality.

This brings us to a point about gradable predicates that Neg-Ex's select for. We've seen that the most natural examples of Neg-Ex's are pejorative; this applies to the gradable predicates as well. With inherently pejorative labels, the examples in (11) are sincere insults. The meliorative predicates in (12), however, are insincere: they are *sarcastic*, thereby being pejorative.

(11) a. Aren't you an idiot!
(...driving while playing a game on your phone?!)
b. Isn't he a jerk!
(...he made a little girl cry!)

(12) a. Isn't he a genius!
(...he tried to charge his phone in the microwave?!)
b. Aren't you lucky!
(...5 exams in one day!)

Note that Pos-Ex's do not have this sarcasm effect for meliorative predicates; the examples in (13) are both sincere.

(13) a. Boy, is he a genius!
(…I can't believe he invented wireless phone chargers!)

b. Damn, are you lucky!
(…your exams were cancelled?!)

The contrast between Pos-Ex's and Neg-Ex's is illustrated below. The context in which you might say *isn't this fantastic!* is a situation in which things aren't fantastic at all, e.g., (14b); it is infelicitous in opposite cases like (15b). Although you can always force a sarcastic reading for Pos-Ex's, it is by no means the default reading — making the neutral reading of (14a) unnatural.

(14) (You spill coffee right before a job interview.)

a. ?? Boy, is this fantastic!

b. Well isn't this fantastic!

(15) (Free upgrade to business class on an international flight.)

a. Boy, is this fantastic!

b. ?? Well isn't this fantastic!

Curiously, when a pejorative/sarcastic reading is not possible with a predicate (e.g., *salad*), the Neg-Ex induces a state-the-obvious effect:

(16) Isn't that a salad! (…lettuce, tomatoes, onions, cheese, croutons, the works!)
'that salad has a lot of salad properties'

I can imagine exclaiming this in reference to a giant salad with lots of ingredients in it. The effect can be approximated as 'having a lot of salad properties', 'a very salad-y salad', or perhaps 'no doubt a salad.'

The next natural question is this: are Pos-Ex's and Neg-Ex's the same, as long as the predicate is pejorative? The answer is no. Here is one such example. The assumption is that running out of milk while pouring a glass is surely *inconvenient*, but not *very* inconvenient.

(17) (You run out of milk while you're pouring a glass.)

a. Well isn't this inconvenient!

b. ?? Boy, is this inconvenient!

My judgment is that the Pos-Ex in (17b) is overly dramatic. It has the same sense of infelicitousness as saying *this is very inconvenient* in this context. In my analysis, this will follow from the fact that Pos-Ex's have a degree component to them. Neg-Ex's on the other hand clearly cannot mean *very*. The source of intensification is hard to articulate, but I think what is helpful here is the *no-doubt-a-salad salad* example from before: running out of milk while pouring a glass is *for sure* inconvenient for the pourer, even if it is not *very* inconvenient. This difference between certainty vs. degree extremity is what separates the two inversion exclamatives.

3. Previous accounts of exclamatives

Modeling the intensified degree reading of WH-exclamatives has been the objective of many studies (Grimshaw, 1979; Gutiérrez-Rexach, 1996; Portner and Zanuttini, 2000; Zanuttini and Portner, 2003; Castroviejo Miró, 2006, 2008b; Rett, 2008; Abels, 2010; Rett, 2011; Chernilovskaya and Nouwen, 2012; Delfitto and Fiorin, 2014: and many more), but how inversion exclamatives intensify — from both descriptive and theoretical perspectives — has played a relatively minor role in painting a more general picture of what the exclamative force is (see Rett (2008, 2011) for a brief discussion on Pos-Ex's; for Neg-Ex's, see Taniguchi (2016)).

In this section I will provide an overview of two popular theories regarding exclamatives, which will be useful for approximating where my analysis falls in the debate concerning the semantics of exclamatives: *exclamatives are questions* vs. *exclamatives are degree constructions*. Both approaches ultimately face difficulty with accounting for exclamatives that do not have a degree interpretation, i.e., Neg-Ex's.

3.1. Exclamatives are questions

In what I call the *question approach* to exclamatives, the semantics of exclamatives derive from actual questions. A WH-Exclamative (WH-Ex) like *How tall Steve is!* therefore underlyingly has the semantics of the question *How tall is Steve?* (Gutiérrez-Rexach, 1996; Zanuttini and Portner, 2003; Chernilovskaya, 2010). I will outline Zanuttini and Portner (2003)'s approach specifically here.

Assuming a Hamblian semantics of questions, the denotation of *How tall is Steve?* is the set of possible answers to this question. For any average person, this might range from 5ft to 6ft, for example:

(18) $[\![\text{How tall is Steve?}]\!] = \left\{ \text{ 5'0", 5'1", 5'2"} \ldots \text{ 5'10", 5'11", 6'0" } \right\}$

The fact that exclamatives have this question semantics clashes with the traditional observation that exclamatives are also factive: they embed under factive predicates (e.g., *know*) but not under non-factive predicates (e.g., *don't know*), at least under the degree interpretation of the WH-clause (Grimshaw, 1979; Abels, 2010). This is shown in (19), with *very* helping to bring out the exclamative interpretation.

(19) a. I know how (very) tall John is
b. # I don't know how (very) tall John is

This means that exclamatives are factive questions — and factive questions are uninformative: you are essentially asking a question while knowing the answer. Zanuttini and Portner (2003) propose that *domain widening* is responsible for making exclamatives informative. What sets exclamatives apart from questions is the inclusion of an exceptional alternative that would not normally be in the domain: the domain *widens* to include an exceptional answer to the question.

Under the same context of Steve's possible height, we may consider *6'5"* as an answer, for example:

(20) $[\![\text{How tall Steve is!}]\!] = \left\{ \text{5'0", 5'1", 5'2"} \ldots \text{5'10", 5'11", 6'0",} \textbf{ 6'5"} \right\}$

This widening effect is responsible for the deviation-from-the-norm reading, and makes an otherwise defective question utterance-worthy. One criticism of the domain widening approach has been that it overgeneralizes: it does not specify what the source of the exceptionality is for the exceptional alternative. For example, it is not able to bar *how tall Steve is!* from meaning 'Steve's height (5'11") is the same number as my street number (511),' despite the arguable noteworthiness of such a coincidence.

For more immediate purposes, it is not immediately clear how domain widening would apply to to exclamatives with yes/no question forms, since yes/no questions have a strictly binary set of answers — p or $\neg p$ — which is unwidenable:

(21) a. $[\![\text{Is he an idiot?}]\!] = \left\{ \begin{array}{l} \text{He is an idiot} \\ \text{He is not an idiot} \end{array} \right\}$

b. $[\![\text{Boy, is he an idiot!}]\!] = \left\{ \begin{array}{l} \text{He is an idiot} \\ \text{He is not an idiot} \\ ??? \end{array} \right\}$

(22) a. $[\![\text{Isn't he an idiot?}]\!] = \left\{ \begin{array}{l} \text{He is an idiot} \\ \text{He is not an idiot} \end{array} \right\}$

b. $[\![\text{Isn't he an idiot!}]\!] = \left\{ \begin{array}{l} \text{He is an idiot} \\ \text{He is not an idiot} \\ ??? \end{array} \right\}$

Even if we were to somehow propose a widening mechanism for polar questions, since both negative and positive inversion questions would have the same set of answers, this predicts Neg-Ex's and Pos-Ex's to have the same semantics. This lack of variability is problematic if we are to model attested differences between the two constructions.

3.2. Exclamatives are degree constructions

A competing position is that exclamatives do not have the semantics of questions, but rather, that there is a degree morpheme responsible for the exclamative interpretation (Castroviejo Miró, 2006, 2008b, a; Rett, 2011; Wood, 2014)[2]. I will summarize Rett (2011) as an example here.

For Rett, exclamatives encode two two illocutionary operators: an exclamation force operator (E-FORCE) and a degree measurement operator (M-OP):

[2] Castroviejo Miró (2008b) and Wood (2014) do incorporate questions into their analyses, although a degree morpheme, rather than domain widening, is ultimately responsible for the degree interpretation of exclamatives for them.

(23) M-OP: $\lambda d \lambda P \lambda x.P(x) \wedge \mu(x) = d$

(24) E-FORCE(p), uttered by SPKR$_C$, is appropriate in a context C if p is salient and true in w_C. When appropriate, E-FORCE(p) counts as an expression that SPKR$_C$ had not expected that p.

E-FORCE adds the evaluative content of the exclamative: it encodes the speaker's surprise about a degree that holds for some property. This accounts for the degree interpretation of exclamatives like *How tall Steve is!*, where the speaker is surprised by Steve's height (i.e., he is very tall). One advantage of strictly tying the exclamative force to degrees in this way is that non-degree interpretations of surprise can be ruled out. Even if it is surprising that Steve's height (5'11") matches my street number (511), "Steve's height = my street number" does not fall on a scale; it is not a degree, therefore it cannot be the target of surprise for exclamatives.

M-OP is necessary when the predicate to be exclaimed about lacks a scale. For example, *what a teacher!*, where *teacher* is not gradable. M-OP gives predicates like *teacher* a contextually determined scale; the scale of *amazingness* for a teacher for example. Her example, *What desserts John baked!*, with the help of M-OP, may mean 'what delicious desserts John baked' if the context is appropriate. The derivation for *What desserts John baked!* is shown below.

(25) What desserts John baked!
   a. ⟦M-OP desserts⟧ = $\lambda d.\lambda x.\text{desserts}'(x) \wedge \mu(x) = d$
   b. ⟦What desserts John baked⟧
   = $\lambda d.\exists x[\text{baked}'(j,x) \wedge \text{desserts}'(x) \wedge \mu(x) = d]$

M-OP first makes *desserts* gradable, and assigns it a scale (e.g., deliciousness) and gives it a degree argument. At this point a degree d' would be provided by the context, leaving the unbound expression $\exists x[\text{baked}'(j,x) \wedge \text{desserts}'(x) \wedge \mu(x) = d']$. This is existentially closed by E-FORCE, which also adds the illocutionary force of speaker surprise:

(26) a. $p = \exists x[\text{baked}'(j,x) \wedge \text{desserts}'(x) \wedge \mu(x) = d']$
   b. E-FORCE(p) counts as an expression if $\exists d'$ such that s_C had not expected that $d' \in D$
   c. Existential closure via E-FORCE: $\exists d'.\exists x[\text{baked}'(j,x) \wedge \text{desserts}'(x) \wedge \mu(x) = d']$ + Illocutionary force "speaker didn't expect p"

What desserts John baked! therefore means that the speaker is surprised that the desserts John baked are so delicious (or whatever contextually salient property). Rett speculates how E-FORCE and M-OP might apply to Pos-Ex's[3] as well:

(27) Wow, did Sue win that race!

She observes that (27) does not express speaker surprise about *Sue* winning the race, which is an individual-oriented reading. It has an event-oriented reading: the manner in which Sue won the race is noteworthy. Following this, she analyzes Pos-Ex's as an exclamation about

[3]She calls them *inversion exclamatives*.

eventualities, which inherit degreehood from M-OP. She remains agnostic as to why inversion exclamatives specifically care about eventualities. Tying inversion exclamatives to eventualities poses an issue, however, since some states[4] are incompatible with Pos-Ex's:

(28) a. Boy, is Ash an idiot!
b. # Boy, is she a teacher!
c. # Boy, did she hold that baby!

(28a) is unproblematic: the state of Ash being an idiot is remarkable and surprising in some way. The contrast in (28b) and (28c) are problematic, since under this analysis M-OP should still kick in to assign these eventualities a degree — but it does not. In other words, why can't (28b) and (28c) mean that the way she is a teacher or the way she held the baby is remarkable?

Contrasting Neg-Ex's with Pos-Ex's is also not easy under this account, which posits that the source of variation between different exclamative constructions is what M-OP targets. If Pos-Ex's scalarize eventualities, then what do Neg-Ex's scalarize? Borrowed unmodified, it is not obvious how M-OP would be manipulated to distinguish the two inversion exclamatives.

My proposal is closest to the question approach, although I abandon domain widening as the mechanism responsible for the intensificative meaning of inversion exclamatives. I will argue that a morpheme inherent to Pos-Ex's and a separate morpheme underlying Neg-Ex's are each responsible for generating the distinct intensificative effect for each construction. As a bonus point, analyses for both of them will derive from their question counterparts, which I will pick up as a tool for my analysis in the following section.

4. Tools

4.1. The question counterparts

I will be assuming the standard treatment of the semantics of questions as a set of possible answers (Hamblin, 1973; Karttunen, 1977). That is, the meaning of a polar quesion like *did Ash win?* will be treated as the set of the possible answers to this question, namely, *Ash won* and *Ash did not win*:

(29) a. Did Ash win?
b. $\{\mathbf{win}(\mathbf{a}), \neg\mathbf{win}(\mathbf{a})\}$

Compositionally, one might imagine an interrogative force head that turns its propositional complement into such a question. For explicitness, I will treat the interrogative force as an instruction to add a question to the set of questions under discussion (QUDs) in the discourse. This is shown in (30).

[4] Assuming eventualities to include events and states.

(30) $[\![\text{Q}]\!] = \lambda p.\text{QUD} + \{p, \neg p\}$
  a. $[\![\text{Did Ash win?}]\!] = [\![\text{Q Ash won}]\!]$
  b. $= \lambda p.\text{QUD} + \{p, \neg p\}(\text{Ash won})$
  c. $= \text{QUD} + \{\mathbf{win}(\mathbf{a}), \neg\mathbf{win}(\mathbf{a})\}$
  'Add *Did Ash win?* to the QUD'

How is a negative polar question such as *Didn't Ash win?* different from this? One observation is that negative inversion questions have a *speaker bias* for the positive answer (Ladd, 1981; Romero and Han, 2004). In (31) the speaker has some certainty that Ash won, and the most felicitous use of the question is when they are "double checking" that their belief is indeed true. This means that in a neutral information-seeking context like the questionnaire scenario in (32), negative inversion questions are infelicitous.

(31) Didn't Ash win?
  'I think Ash won, but I want to make sure'

(32) [*On a demographic questionnaire:*]
  a. Do you have children?
  b. # Don't you have children?

This speaker bias has been analyzed using the notion of *verum*. *Verum* — the emphasis of truth — manifests in some lexical items like *really* in English, but also as auxiliary focus (dubbed *verum focus* by Höhle (1992)):

(33) a. Ash *really* won
  b. Ash $[\text{did}]_F$ win

The examples in (33) both mean 'Ash won' at the basic level, but there is an emphatic quality to the utterance: I am *certain* that Ash won.

Romero and Han (2004) view VERUM as an epistemic operator that encodes the speaker's desire for a proposition *p* to be added to the common ground (CG). If the CG is the set of propositions that discourse participants mutually agree to be true (Stalnaker, 1978, 1998, 2002), VERUM(p) says that *p* should be in this set. Their implementation, reformulated slightly for readability, is below:

(34) $[\![\text{VERUM}]\!] = \lambda p \lambda w. \forall w' \in \text{EPI}_{\text{SPKR}}(w) \cap \text{CONV}_{\text{SPKR}}(w)[p \in \text{CG}_{w'}]$
(reformulated, Romero and Han (2004))

$\text{EPI}_{\text{SPKR}}(w)$ is the set of worlds that conform to the speaker's beliefs in *w*, and $\text{CONV}_{\text{SPKR}}(w)$ is the set of worlds that conform to the speaker's conversational goals in *w* (i.e., the worlds in which there is maximal true information). Therefore, (34) says that in an ideal world w' in which what the speaker believes in *w* is indeed true, *p* is in the common ground. This translates into, from the perspective of the speaker, '*p* should be added to the common ground.' Romero and Han shorten this as FOR-SURE-CG(*p*).

The denotation for *Ash* $[did]_F$ *win* — a *verum*-focused sentence — then would simply be FOR-SURE-CG(Ash won), in other words, '*Ash won* should be added to the CG.' This is one way of modeling the sentiment of '*p* is definitely true.'

Didn't Ash win? is the question version of FOR-SURE-CG(Ash won) according to Romero and Han; the pre-posed negation signals the presence of a VERUM operator.[5] That is, *Didn't Ash win?* decomposes into ⟦Q VERUM Ash won⟧. This is shown below.

(35) Didn't Ash win?
  a. ⟦Didn't Ash win?⟧ = ⟦Q VERUM Ash won⟧
  b. $= \lambda p.\text{QUD} + \{p, \neg p\}$(VERUM Ash won)
  c. $= \text{QUD} + \{$VERUM Ash won, $\neg$VERUM Ash won$\}$
  d. $= \text{QUD} + \{$FOR-SURE-IN-CG(Ash won), $\neg$FOR-SURE-CG(Ash won)$\}$
  'Add this to the QUD: Are we for sure putting *Ash won* in the CG?'

Romero and Han's explanation of the speaker bias goes like this. Making reference to meta-discourse pieces like the CG is a marked move, and should be avoided if necessary. VERUM makes reference to the CG. A context in which such a move is necessary is when the speaker believes one of the answers is true, but there is evidence that another discourse participant does not share this belief. In this way, the negative inversion question becomes a necessary halt to the discourse to set things straight, to check that everyone is on the same page. But this only arises if the speaker has a bias in the first place.

4.2. Man

I will briefly outline an additional tool here: the obligatory sentence-initial particle in Pos-Ex's (e.g., *boy* is he an idiot!). I take this to be the same creature as McCready (2008)'s *man*. These particles can precede normal propositions as well:

(36) Man, Ash is immature!
  'Ash is very immature (and I have strong feelings about this)'

Suppressing the discussion of the emotive/attitudinal content associated with the particle (see McCready (2008) for an analysis), what *man* roughly is is a long-distance *very*. It means that *immature* holds to a high degree in this case.

The issue is that *man* takes a propositional complement, which is not gradable. What is gradable is the predicate that is inside. To bridge this gap, McCready proposes a type shifter: SD (for *sentence degree*), shown below.

[5] Possibly mood agreement; or, VERUM could be directly encoded in the negation. I remain agnostic about the status of the negation.

(37) $[\![\textsc{sd}]\!] = \lambda p \lambda d.p(d)$ (McCready, 2008)
where $\lambda d.p(d)$ is a set of degrees that satisfy a gradable predicate in p; undefined if no such predicate.

For example, $[\![\textsc{sd}]\!]$(Ash is immature) would return $\lambda d.\mathbf{immature}(Ash)(d)$. If on the other hand the proposition were *this is non-refundable*, the type shifting would be unsuccessful since *non-refundable* is not gradable. This prevents *boy* from being able to apply to non-gradable predicates (e.g., #Boy, this is non-refundable!).

Once a gradable predicate is extracted from the proposition, *man* just has to say 'very' of it. One formulation of this is shown in (38); $\gg$ should be read as 'exceeds by a large amount.' Note that this is a large simplification of McCready's account.

(38) $[\![\text{man/boy/damn/shit/god/jesus}]\!] = \lambda D_{\langle d,\langle s,t\rangle\rangle}.\exists d.D(d) \wedge d \gg \mathbf{standard}_C(D)$
(modified from McCready (2008))

This is equivalent to the denotation of *very*. McCready has a discussion of this degree modification being at the expressive level, but I will suppress the multidimensional nature of *man/boy* for the sake of simplicity here. I will return to this point in my discussion later in the paper, however.

5. Analysis

Here is what we are trying to account for:

1. Inversion exclamatives look like inversion questions, but aren't answerable

2. Positive inversion exclamatives are incompatible with non-gradable predicates

3. Negative inversion exclamatives don't mean 'very,' but rather 'I am certain.'

My proposal for #1 above is that exclamatives *are* questions — just self-answered ones. I propose an exclamative operator EX-OP, akin to the question operator Q. EX-OP is exactly like Q, except that the answer is provided:

(39) $[\![\textsc{ex-op}]\!] = \lambda p \lambda w.\{p, \neg p\} + \textsc{qud}_w \wedge p(w)$
'Turn p into a polar question, and simultaneously answer affirmatively'

This allows for exclamatives to take on the role of a question and an assertion simultaneously.

Let us step through a Pos-Ex example to illustrate this. *Boy, is Ash immature!* has the base proposition *Ash is immature*, to which EX-OP applies:

(40) $[\![$is Ash immature!$]\!]$ = $[\![$EX-OP Ash is immature$]\!]$ =
$\lambda w.\{\mathbf{immature}(\mathbf{a}), \neg\mathbf{immature}(\mathbf{a})\} + \text{QUD}_w \wedge \mathbf{immature}_w(\mathbf{a})$
'Is Ash immature? Yes, Ash is immature.'

At this point, this is utterly uninformative: what is the point of a self-answered polar question? To make this mini self-monologue informative, we must intensify the answer.[6] This is why *boy* and the like are obligatory for this construction. Its contribution (with the help of SD) is articulated below.

(41) $[\![$SD$]\!]$ (EX-OP Ash is immature)
$= \lambda d\ [\lambda w.\{\mathbf{immature}(\mathbf{a}), \neg\mathbf{immature}(\mathbf{a})\} + \text{QUD}_w \wedge \mathbf{immature}_w(\mathbf{a})](d)$
$\rightsquigarrow \lambda d \lambda w.\mathbf{immature}_w(\mathbf{a})(d)$
'the set of degrees that satisfy **immature**(**a**)'

(42) $[\![$boy$]\!]$($[\![$SD EX-OP Ash is immature$]\!]$)
$= \exists d.\lambda w.\mathbf{immature}_w(\mathbf{a})(d) \wedge d \gg \mathbf{standard}_C(\mathbf{immature})$
'Ash is very immature'

In other words, *boy, is Ash immature!* ends up meaning 'Is Ash immature? He is immature. *Very* immature.' This easily explains why Pos-Ex's are only compatible with gradable predicates: their incompatibility with non-gradable predicates reduces to *boy*'s incompatibility with such predicates.

If *boy* is the culprit in Pos-Ex's, the morpheme responsible for the intensified reading in Neg-Ex's is VERUM. The connection is intuitive if we assume that exclamatives derive from questions: if *Isn't Ash immature?* decomposes into $[\![$Q VERUM Ash is immature$]\!]$, then *Isn't Ash immature!* breaks down into $[\![$EX-OP VERUM Ash is immature$]\!]$. Let's see how this works.

(43) $[\![$isn't Ash immature!$]\!]$ = $[\![$EX-OP VERUM Ash is immature$]\!]$
a. $[\![$VERUM Ash is immature$]\!]$
b. $= \lambda w.\forall w' \in \text{EPI}_{\text{SPKR}}(w) \cap \text{CONV}_{\text{SPKR}}(w)[\mathbf{immature}(\mathbf{a}) \in \text{CG}_{w'}]$
$\rightsquigarrow$ FOR-SURE-CG(Ash is immature)
'We should add *Ash is immature* to the common ground'
c. $[\![$EX-OP$]\!]$(VERUM Ash is immature)
d. $= \lambda w.\{\text{FOR-SURE-CG}(\mathbf{immature}_w(\mathbf{a})), \neg\text{FOR-SURE-CG}(\mathbf{immature}_w(\mathbf{a}))\} + \text{QUD}_w \wedge \text{FOR-SURE-CG}(\mathbf{immature}_w(\mathbf{a}))$
'Should we add *Ash is immature* to the common ground? Yes, we should.'

This translates into the speaker's strong conviction that Ash is immature. How is this different from *Ash* $[is]_F$ *immature*, which also asserts FOR-SURE-CG(Ash is immature)? I think this may have to do with the fact that *verum* focus is infelicitous out-of-the-blue (Gutzmann and Castroviejo Miró, 2011). For example, if you meet Ash for the first time and simply want to express how certainly immature he is, (44) is very strange.

[6] This is the same line of reasoning as Zanuttini and Portner (2003)'s motivation for domain widening.

(44) (You meet a guy named Ash. He keeps on launching spitballs at people with a straw.)
$^{??}$Ash $[\text{is}]_F$ immature!

Gutzmann and Castroviejo Miró (2011) propose that this is because in order for *verum*(p) to be felicitous, *whether p* must be in the QUD in the first place. The intuition is that when you are very sure of something, there must be a reason to assert that; otherwise, just *p* would suffice. One way to make "I am sure" felicitous out of the blue is to turn it into a Neg-Ex, which has an implicit question component to it. Since you've snuck "are we sure?" into the QUD with it, you are able to assert "I am sure." I suggest that this is why Neg-Ex, even as a self-answered question, is informative. This explains why *Isn't Ash immature!* in the same context as (44) would be completely natural for expressing how blatantly immature Ash is.

6. Discussion

An observant reader may have noticed that my analysis has not yet explained why Neg-Ex's and pejorativity go hand-in-hand. A disappointed reader will hereby learn that I do not have a good explanation for it. I do, however, have some speculations. One interesting property of Neg-Ex's is that the negation must be preposed:

(45) a. Isn't he an expert!
$\approx$ 'He's not really an expert'
b. # Is he not an expert!

As it turns out, many insults occur at the left edge. A kind of exclamative that uses the indefinite *some* normally expresses the noteworthiness of the NP at hand, but when *some-NP* is preposed, it takes on a markedly pejorative flair:

(46) *Some*-exclamatives (Anderson, 2016)
a. He is some expert!
'He is a noteworthy expert'
b. Some expert he is!
'He's not really an expert'

Another pejorative construction is the *schm-* reduplication, which conveys a dismissal (pejorative) attitude towards the reduplicant. Interestingly, *schm-* reduplication must also be preposed:

(47) *Schm*-reduplication (Grohmann and Nevins, 2004)
a. Expert-schmexpert, his facts are half-assed!
b. # He is an expert-schmexpert

Given these facts, I do entertain the idea of *n't* in Neg-Ex's occupying a position responsible for pejorative mood (e.g., PejP in Grohmann and Nevins (2004)). Much more work is needed in this area to confirm or refute this hypothesis. I leave this for future research.

Another issue concerns the level of meaning of *boy/man* and VERUM, which are both crucial ingredients in my analysis. One crucial property of the intensificative nature of pre-sentential particles like *man* is that their meaning is not at-issue; they are expressive particles (McCready, 2008). One way to test at-issue-ness is to see if the relevant part of the meaning can be contradicted:

(48) A: Man, Ash is immature!
B: That's not true, Ash is not immature.

(49) A: Man, Ash is immature!
B: ?? That's not true, Ash is not *very* immature.

When you respond *That's not true!* to *Man, Ash is immature*, what you are saying is false is the propositional content 'Ash is immature,' not the *very*-ness contributed by *man*. This suggests that the intensification via *man* does not have truth-conditional meaning. Rather, it has *expressive* meaning, a dimension separate from at-issue meaning (Potts, 2007).

Similarly, more recent takes on VERUM have shown that its meaning is also not at-issue (Gutzmann and Castroviejo Miró, 2011).

(50) A: Ash $[\text{is}]_F$ immature!
B: That's not true, Ash is not immature.

(51) A: Ash $[\text{is}]_F$ immature!
B: That's not true, you're not certain that Ash is immature. (You just told me a second ago that you weren't sure if he was immature or not)

My judgment is that *that's not true* cannot be targeting the speaker certainty contributed by VERUM. Following the same line of intuition, Gutzmann and Castroviejo Miró (2011) propose a multidimensional semantics of VERUM. What this suggests is that inversion exclamatives may be expressive as well. An explicitly multidimensional treatment of inversion exclamatives has yet to be proposed, but may be fruitful given the insight from the pieces we are playing with. I leave this for future research.

This work opens up the question of what exclamatives are as a sentence type. Exclamatives exclaim, but how? In the case of positive and negative inversion exclamatives, assuming a question semantics of exclamatives gives us a natural account of the subtle differences in the way they intensify meaning. EX-OP turns a proposition into a question and an assertion at the same time. This leads to intensification because without it, a self-answered question is not informative. EX-OP is where these exclamatives converge, but the intensification that results from it is not necessarily limited to degree intensfication as often assumed in the literature. Exclamatives are a more heterogenous class than one might imagine, and the semantic microvariation across exclamative subconstructions are crucial for understanding what the common mechanism across all of them are. My proposal is a simple one of form and meaning: exclamatives look like questions so questionhood must be tied to the intensity they evoke. Although not explicitly discussed here, I would expect WH-exclamatives to tell a similar story. A broader examination of exclamative types will provide a more generalizable understanding of the exclamative force; this seems to me the logical next step in this project.

7. Conclusion

In this paper, I have analyzed the semantics of positive inversion exclamatives (Pos-Ex's) and negative inversion exclamatives (Neg-Ex's). The empirical finding is that Pos-Ex's denote the intensification of degrees while Neg-Ex's express intensified certainty. Neg-Ex's involve the polarity emphasizer VERUM, which it inherits from its question cousin. Pos-Ex's intensify via the obligatory sentence-initial particle *boy*, a degree modifier. The common denominator between the two inversion exclamatives is EX-OP, which encodes exclamative meaning: a question-assertion combination. From this analysis we gain two things: exclamatives are non-information-seeking questions, and different subconstructions of exclamatives have different — but predictable — ways of intensifying. This discussion provides a lens into how natural language encodes noteworthiness and intensity, and relating interrogatives to exclamatives for untangling intensification becomes a broader project of the link between form and meaning.

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"No, I AM": What are you saying "no" to?[1]

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Abstract. The English particle "no" can be used in a variety of contexts. We propose that "no" is three ways ambiguous, distinguished by the type of antecedent utilized: explicit, implicit and exophoric. The second type—"no" with an implicit antecedent—addresses a grounding misalignment caused by sources such as speaker's bias. This type of "no" cannot be used bare. The current semantic theories on "no" as an answer particle to negative polar questions and assertions claim that "no" is ambiguous between confirming and rejecting the polar question or assertion. The preceding negative polar question or assertion licenses and therefore provides the content for "no" in answers like "No, I AM". We argue instead that the ambiguity arises from whether "no" is picking an an explicit antecedent—the queried proposition—or an implicit one—the questioner's bias. We offer three predictions and show that even positive antecedents with implied bias may license the "No, I AM" type of answer; in dialogue, bare "no"s only pick up explicit antecedents; the strength of the bias in a negative question influences the rate of the second type of "no" uses. We formalize our account in the KoS framework (Ginzburg, 2012). Our analysis highlights the importance of potential mismatches between the information states of different conversational participants in meaning resolution.

Keywords: No, negation, dialogue, non-sentential utterance, polarity particle, KoS

1. Introduction

The English polarity particle "no" has several uses: to reject a positive assertion or polar question (example (1)), and to confirm a negative assertion or polar question (example (2)); it can correct a misinterpretation (example (4)); it can be used in the context of agreement (example (5)); and it can be used as a "stop" interjection (example (6)).

(1) -A: John likes chocolate. / Does John like chocolate?
-B: No, he doesn't.

(2) -A: John doesn't like chocolate. / Does John not like chocolate?
-B: No, he doesn't.

(3) -A: You don't use any credit cards, I don't imagine.
-B: No, of course I use [them].
(Switchboard sw3332A-ms98)

(4) -A: How's your girlfriend?
-B: she is no longer my girlfriend.

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-A: Ah, I'm so sorry.
-B: No. She is my wife now.

(5) -A: I think they should also respect the sanctity of the American home, whether it be in a house or in an apartment.
-B: Yeah, yeah, no, I agree with you there.
(Switchboard sw-058-2015)

(6) (A child is about to touch the socket) Adult: No!

The multiple facets of "no" are seldom addressed together. The literature coverage is split between the answer particle uses of "no", addressing examples (1), (2) and (3), and the "discourse marker" uses of "no", addressing examples (4) and (5).

1.1. "No" as an answer particle

Data like examples (1), (2) and (3) are of interest to semanticists who try to account for the ambiguity of "no" as an answer particle. It has been observed that in English, "no" appears in both responses that confirm a negative assertion or polar question, and those that reject one. Some language have an unambiguous negative particle. For example, the French particle "non" can only be used to refer to a negative situation, thus confirming a negative question or rejecting a positive one. A separate particle, "si" takes care of rejecting negative assertions/polar questions (Roelofsen and Farkas (2015)). In line with the proposal of Pope and Katz (1976), Roelofsen and Farkas propose that polar particles have two types of features, ABSOLUTE and RELATIVE. ABSOLUTE features ([+]/[-]) mark a response clause as positive or negative. [-] is marked compared to [+]. RELATIVE features ([AGREE]/[REVERSE]) mark a response as agreeing with or reversing the antecedent. [REVERSE] is more marked than [AGREE]. When "no" answers a negative polar question, the ABSOLUTE feature confirms the queried negative proposition, while the RELATIVE feature rejects the queried negative proposition. Both possibilities can be realized but the latter (rejection) is more marked.

Krifka (2013) proposes that polar questions are anaphors that pick up a salient propositional discourse referent (propDR), introduced by the antecedent. "Yes" asserts a propDR and "no" asserts its negation. A negative assertion or polar question introduces two propDRs: a positive one (more salient) and a negative one. For example, the utterance "Two plus two isn't five." introduces the propDRs "Two plus two is five" and "Two plus two isn't five". Thus, when the antecedent is negative, "no" can negate the positive propDR and therefore confirms it, or negate the negative propDR and therefore rejects it. The former is preferred as the positive propDR is more salient. Under the theories of both Krifka (2013) and Roelofsen and Farkas (2015), the content of "no" is provided by the preceding negative assertion or polar question.

1.2. "No" as a discourse marker

A separate set of studies on "no" come from the field of Conversational Analysis, which analyzes the "discourse marker" uses of "no", aiming at explaining examples like (4) and (5). Lee-Goldman (2011) proposes that "no" can be used as a discourse marker to mark topic shift, to correct misunderstanding and to manage disagreement. Schegloff (2001) proposed a specific use of "no": to mark the transition from non-serious to serious talk. Burridge and Florey (2002) study the uses of "yeah-no" in Australian English, and propose that "yeah-no" is a discourse marker with three functions—propositional, textual and expressive. Propositional "yeah no" indicates both assent and dissent; textual "yeah no" provides cohesion, and expressive "yeah no" is used to express politeness. These Conversational Analysis approaches to "no" list its functions, but do not propose any underlying mechanism linking these uses.

2. Our proposal: argumentation

Building on earlier proposals (Ginzburg and Sag, 2000; Cooper and Ginzburg, 2011), we propose that "no" can be ambiguous because it can pick up different types of antecedents—explicit, implicit or exophoric:

1. **"No" with an explicit antecedent, can be used as a bare particle**: used to respond to an explicit polar question or assertion (Ginzburg and Sag, 2000; Cooper and Ginzburg, 2011). When the antecedent is positive, "no" negates it, as in (1). When the antecedent is negative, "no" reaffirms it, as in (2). In English, "nope" is a specialized lexical item with this meaning.

2. **"No" with an implicit antecedent, cannot be used as a bare particle**: used to correct a **grounding misalignment** between the interlocutors. In such situations, speaker A assumes that a proposition *p* is in the common ground or can enter the common ground. Speaker B disagrees with this assumption, detects the grounding misalignment, and uses "no" to reject that *p* is in the common ground. The source of the grounding misalignment is implicit, such as an epistemic bias (example (3)), an interpretation (example (4)), an expectation (example (5), more details on this later). Note that "no" does not assert the negation of the misaligned proposition *p*, but merely asserts that *p* should not be in the common ground. Therefore, speaker B must provide extra information to fix the misalignment in a complement clause.

3. **"No" with exophoric antecedent, can be used as a bare particle**: used as an interjection to address an exophoric event with a potential outcome, as in example (6) (Cooper and Ginzburg, 2011).

Importantly, we argue that the ambiguity of "no" as an answer to negation assertions or polar questions lies in the types of the antecedent it picks up. "No" in answers like "No, I'm not." (or the "ABSOLUTE" feature in Roelofsen and Farkas (2015)) refers to an explicit antecedent introduced by the preceding negative assertion or polar question, while those in answers like "No, I AM" (the "RELATIVE" feature in Roelofsen and Farkas (2015)) refers to an implicit antecedent: the bias of the question poser. This analysis resembles Krifka (2013)'s analysis of the meaning of "wrong". He proposes that the particles "right" and "wrong" do not pick up a propositional discourse referent, but a discourse referent introduced by a speech act. The words "right" and "wrong" evaluate this referent as being justified or not. Like "no" with an implicit referent, "right" and "wrong" can only answer biased questions.

We argue that the "No, I AM" uses as in example (3) is not licensed by the preceding negative assertion or polar question, but by a bias of the question poser, grouped together with the "discourse marker" uses such as (4) and (5). In (3), "no" is licensed by speaker bias. A expects that B does not use credit cards, and proposes to enter this proposition into the common ground. B uses "no" to reject this expectation. In (4), "no" is licensed by implied misunderstanding. A's utterance "Ah, I'm so sorry" implies an interpretation that B has split up with his girlfriend. B uses "no" to reject this interpretation, and then corrects the misalignment with the clause "she is my wife now". In (5), what "no" rejects is more elusive. In this example, A implies that her opinion regarding the "American home" is exclusive to herself. B uses "yeah" to agree with the content of A's utterance, and then uses "no" to cancel the assumption that the belief is exclusive to A, communicating that in fact the opinion is shared.[2] In all these cases, the first speaker (speaker A) implies that there is a proposition *p* which A believes is in, or can enter the common ground. The interlocutor B uses "no" to assert that *p* cannot enter the common ground. Thus this type of "no" does not pick up the proposition introduced by the immediate preceding utterance itself, but addresses a piece of belief of the interlocutor which causes a grounding misalignment. Due to the implicitness of the antecedent, the second type of "no" cannot be used bare, but must be followed by a clause that corrects the misalignment.

Let us analyse another example.[3] Context: A and B submitted a paper to a journal. After they submitted, they found a big mistake in the argument. They expect that the reviewers will catch the mistake and that the paper will be rejected. Then they get a notification from the journal. A reads the email, which includes a summary of the reviewer reports, and then tells B that the paper has been accepted with minor revisions.

(7) -B: Did none of the reviewers spot our mistake?
-A: No, some of them DID, but the editor still decided to accept the paper with minor revisions.

One might argue that in this example, B's bias/expectation was that some of the reviewers did spot the mistake, so by uttering "no", A did not reject this expectation, but rather confirmed it. So it cannot be that "no" is used here to signal rejection of an implicit bias. Still, it is licensed. Therefore, the fact that the preceding polar question provides a negative explicit antecedent seems crucial.

[2]We do not claim that this is the meaning of "no" in all "yeah-no" sequences, nor do we claim that "yeah-no" somehow functions together as a discourse marker, countering Burridge and Florey (2002) We believe that the antecedents of "yeah" and "no" are resolved independently. Often, "yeah" expresses agreement/ compliance, but "no" can be used to refer to an explicit antecedent, for example "(SP:PS0FP) Jonathan. Don't keep doing that. (SP:PS0FR) (unclear) (SP:PS0FX) Yeah (unclear) (SP:PS0FP) (shouting) Yeah no don't." (BNC KCT); or to an implicit antecedent like (5).

[3]We thank an anonymous SuB21 reviewer for suggesting this example.

We argue that in this example, "no“ still picks up an implicit antecedent. It illustrates that a speaker's biases can have different sources. Sudo (2013) discusses two sources of biases associated with polar questions: epistemic and evidential. An epistemic bias is one where the question poser has a prior expectation towards a proposition, but there is no immediate evidence in the common ground supporting this proposition. In English, the profile of the presence of a positive epistemic bias and the absence of an evidential bias is often communicated using high-negation polar questions, such as "Won't the reviewers spot our mistake?", implying that the speaker expects that reviewers will spot their mistake. On the other hand, an evidential bias is one where there is immediate evidence in the common ground (available to both conversational participants) which supports a proposition. The profile of the presence of a negative evidential bias and presence or absence of a clashing epistemic bias is often communicated using low-negation polar questions, such as "The reviewers didn't spot our mistake?/ Did they not spot our mistake?". (7) communicates a negative evidential bias that "the reviewers did not spot our mistake" and a clashing positive epistemic bias that the speaker previously expected otherwise. The evidential bias (that no one spotted the mistake) was indirected supported by the fact that the paper was accepted. Speaker A's response "No, some of them DID" corrects B's evidential bias.

3. Our proposal: Formalization

To formalize our proposal, let us first review the features that need to be captured. We have proposed three types of "no"s, distinguished by the type of contextual antecedent they utilize. As a novel contribution, we propose a type of "no" used when there is a *grounding misalignment*, referring to a belief proposition of the interlocutor. To capture this, we need a semantic framework that (a) centralizes the role of context, as the meaning of "no" is partially supplied (and disambiguated) by the context; (b) represents *separate* contexts for each conversation participant; and (c) has significant internal structure by means of which it represents content other than the illocutionary content of the utterance. These features are best handled by semantic theories rooted in dialogue.

3.1. KoS

KoS—a toponym, not an acronym—(for recent surveys, see Ginzburg and Fernández (2010); Ginzburg (2012, 2016), for motivation of its view of grammar, see Ginzburg and Poesio (2016)) is a theory that combines an approach to semantics inspired by situation semantics and dynamic semantics with a view of interaction influenced by Conversational Analysis. On the approach developed in KoS, there is actually no single context—instead of a single context, analysis is formulated at a level of information states, one per conversational participant. Each information state consists of two 'parts', a private part and the dialogue gameboard that represents information that arises from publicized interactions. We focus on the dialogue gameboard. For current purposes, it will be sufficient to assume a simplified specification of its *type* as given in (8)[4]—the *spkr,addr* fields allow one to track turn ownership, *Facts* represents conversationally

[4]The relevant notion of 'type' is drawn from Type Theory with Records, for which see Cooper and Ginzburg (2015).

shared assumptions, *Moves* represents the contents of moves that have been grounded, *QUD* tracks the questions currently under discussion:

(8) DGBType $=_{def}$

$$\begin{bmatrix} \text{spkr : Ind} \\ \text{addr : Ind} \\ \text{utt-time : Time} \\ \text{c-utt : addressing(spkr,addr,utt-time)} \\ \text{Facts : Set(Proposition)} \\ \text{Moves : list(illocutionaryProposition)} \\ \text{QUD : poset(Question)} \end{bmatrix}$$

Lexical entries and grammar rules interface with the DGB by specifying values that the latter needs to instantiate via a field 'dgb-params'. Thus, for instance, a lexical entry for a greeting word such as "hi" involves a specification for the initial context of a conversation, one in which no moves have been made and no issues introduced:

(9)
$$\begin{bmatrix} \text{phon : } \texttt{hi} \\ \text{cat.head = interj : syncat} \\ \text{dgb-params : } \begin{bmatrix} \text{spkr : IND} \\ \text{addr : IND} \\ \text{utt-time : TIME} \\ \text{Moves = } \left\langle \right\rangle \text{: list(LocProp)} \\ \text{qud = } \left\{ \right\} \text{: set(Question)} \end{bmatrix} \\ \text{cont = Greet(spkr,ind,utt-time) : IllocProp} \end{bmatrix}$$

3.2. Three times "no"

Working backwards from the last example we discussed in Section 1, we first specify the type of "no" used as an interjection (the third type in Section 2). This type of "no", arguably, has ontogenetic priority. The context is one in which there is a potential state of affairs or *outcome* (in example (6), the potential outcome would be the child touching the socket). "No" expresses a negative volition to this *outcome*. It is both used in addressing young children and by young children gesturally (Morgenstern et al. (2016)). Cooper and Ginzburg (2011) propose the following lexical entry for this use:

(10) **"No" with exophoric antecedent**

$$\begin{bmatrix} \text{phon} : \texttt{no} \\ \text{cat.head} = \text{interjection} : \text{syncat} \\ \text{dgb-params} = \begin{bmatrix} \text{o} : \text{Outcome} \\ \text{spkr} : \text{Ind} \end{bmatrix} : \text{RecType} \\ \text{cont} = \neg\text{Want(spkr,o)} : \text{Prop} \end{bmatrix}$$

Now to address the "discourse marker" uses and "no" used to reject negative assertions or polar questions, "no" with implicit antecedent presupposes that there is a misalignment between the Dialogue Gameboards of the two conversational participants. One participant believes (or has high confidence) that a proposition *r* should be in the common ground, but the other participant believes otherwise. The belief proposition *r* can be introduced by biased question forms (example (3)), implicatures (example (4), attitude verbs, e.g. "I think" (example (5), prosody or even nonverbal means like facial expressions. The meaning of this type of "no" is represented as follows. The addressee (previous speaker) believes *r*, and the current speaker uses "no" to assert that *r* is not true.

(11) **"No" with implicit antecedent**

$$\begin{bmatrix} \text{phon} : \texttt{no} \\ \text{cat.head} = \text{interjection} : \text{syncat} \\ \text{dgb-params} : \begin{bmatrix} \text{spkr} : \text{Ind} \\ \text{addr} : \text{Ind} \\ \text{c} : \text{addressing(spkr,addr)} \\ \text{r: Prop} \\ \text{c1: Believe(addr,r)} \end{bmatrix} \\ \text{content} = \neg\text{r} \end{bmatrix}$$

Lastly, we address the examples of "no" used as an answer particle that rejects a positive question or confirms a negative one. The context of this use of "no" is its most ubiquitous in adult use, namely bare, as a response particle. It presupposes that in the context, the current Question Under Discussion (max-QUD) is a polar question.[5] "No" always denotes a negative proposition: it negates the queried proposition if the max-QUD is positive, and is identical to the queried proposition if the max-QUD is negative. We propose the following lexical entry for this use, which refines earlier proposals in Ginzburg and Sag (2000); Cooper and Ginzburg (2011).

[5] Ginzburg (2012) proposes that an assertion *p* gives rise to the QUD *whether p*. Therefore, this account assumes that the max-QUD after both a polar question and an assertion is a PolQuestion.

(12) **"No" with explicit antecedent**

$$\begin{bmatrix} \text{phon : } \texttt{no} \\ \text{cat.head = interjection : syncat} \\ \text{ARG-ST} = \left\langle \right\rangle\text{: elist(synsem)} \\ \text{dgb-params.max-qud : PolQuestion} \\ \text{cont : NegProp} \\ \text{c1: (cont = maxqud([]))} \vee \\ \mathit{maxqud}([]) \not{:} \mathit{NegProp} \wedge \mathit{cont} = \neg \mathit{maxqud}([]) \end{bmatrix}$$

4. Three predictions and their evaluation

Our theory makes three predictions:

Prediction I: Even positive assertions (*p*) or polar questions (*p?*) can license the "No, I Am" type of answers, as long as the speaker implies a bias that is different from *p*.

Consider this example, a group of friends are talking about who should cook for the party. Most of them eat meat, and they each propose what they would cook. Amie, who is vegetarian, says "well I can do tofu burgers and soya pudding. I bet you are all excited about that!". In this context, one can say "No, I AM. That will be interesting!". Here, "no" is used with a positive clause, as a response to a positive antecedent. This is not allowed under current semantic theories.[6]

Prediction II: Without the help of prosody, when "no" is used as a bare particle following a negative assertion or polar question, it can only pick up an explicit antecedent (interpreted as confirmation).

To evaluate this prediction, we conducted a corpus study, looking at responses to negative polar questions in the Switchboard Dialogue Act Corpus (Jurafsky et al., 1997). Negative polar questions are rare compared to positive ones, at a ratio of 1:13. Looking at answers to negative polar questions (summarized in Table 1), we found that confirming answers out-ratio rejecting answers at 5.8:1, higher than the ratio of 2:1 following positive questions, suggesting that negative questions are more biased. When a negative question *is* rejected, most often no particle was used at all. In such cases answers containing "no" are much more likely to be a confirmation than a rejection. Bare "no"s are used only to confirm (as seen in examples (13) and (14)). They do not seem to cause confusion, as we found no clarification questions following bare "no"s. The corpus data supports our prediction that bare "no"s follow negative assertions or polar questions can only pick an explicit antecedent.

[6]It has been pointed out to us that this example is compatible with Krifka (2013), if we assume that an ironic utterance *p* introduces *not p* as a discourse referent. This argument does not contradict our analysis that here "no" picks up an implicit antecedent.

(13) -A: Didn't like it?
-B. No.
(Switchboard sw_0143_2290)

(14) A: But, I mean, it doesn't give you trouble?
-B: No.
(Switchboard sw_0762_3371)

Answer	Confirmation	Rejection	Not answered
"No" with clause	84	3	
Bare "No"	**28**	**0**	
"Yes"	13	4	
Answers without polar particle	31	15	
Total	128 (76%)	22 (13%)	19 (11%)

Table 1: Distributions of "No" and "Yes" particles used in confirming or rejecting answers to negative polar questions—data from Switchboard

A similar point was made by Roelofsen and Farkas (2015), who noticed that when answering negative assertions or polar questions, bare particle responses are considerably less felicitous than ones accompanied by an answer clause (illustrated in example (15)). Kramer and Rawlins (2012) tested the interpretation of bare particle responses in different contexts, and found that in response to a negative polar question, both bare "yes" and bare "no" are more often interpreted as confirming the negative question than rejecting it.

(15) -A: Did Peter not pass the text? / Peter didn't pass the test.
-B: ?No. / No, he didn't pass. / No, he DID pass.

Prediction III: Biased negative polar questions can license the "No, I AM" type of answers (the "RELATIVE" use), but neutral questions cannot.

Under our theory, in answers to negative polar questions, the second type of "no" (the "RELATIVE" feature under Roelofsen and Farkas (2015)) is licensed not by the explicit question itself, but by the speaker bias that is often present when a negative question is posed. Therefore, in contexts where the question poser is neutral, we should not expect this type of answer. We ran a production experiment testing whether the strength of the speaker bias in a negative polar question influences the ratio of "RELATIVE" use of "no". The prediction is that the weaker the speaker bias, the fewer the "No, I AM" type answers.

Participants: 50 participants were recruited via Amazon Mechanical Turk. We did not specify any native language requirements, but instead asked them to say what their native language(s) is/are. In this experiments, all 50 participants indicated that English was their native language. There were 28 females and 22 males. The average age was 33 years.

Design and materials: We constructed two dialogues, each containing two negative polar questions and three positive polar questions as fillers. The following turn of these questions is left empty, and participants are asked to freely fill the empty lines so that the dialogue sounds coherent and natural. The first dialogue is between the character Charlotte and a health worker who is conducting a survey in the community. The second dialogue is between Charlotte and a newly acquainted friend. In each dialogue, we tried to make one negative question weakly biased/neutral, while the other strongly biased. To create the context for a weakly biased question, we made the negative proposition salient in the context, but imply that the questioner is genuinely ignorant of the answer. To create the context for a strongly biased question, we planted indirect and insufficient evidence which suggest that the queried negative proposition might be true. The experimental questions are:

(16) Dialogue 1 background information: A health worker came to the community to talk to the residents because there is a worry concerning a minor infectious disease. However people who have had chickenpox have a reduced chance of contracting it.
(The health worker introduces herself and the purpose of the survey, then asks a question about where they lived and whether they have young children.)
-Health worker: You probably have heard that, if you have never had chickenpox, you are more likely to get infected. **Have you not had chickenpox before?** (*weakly biased question*)
-Charlotte: *(answer to be filled by participant).*
...
-Health worker: Ah you guys just moved here, I see. **So is your nationality not American?** *(strongly biased question*)
-Charlotte: *(answer to be filled by participant).*
...

(17) Dialogue 2 background information: You are chatting with a new friend who you recently met in the local market. Her name is Sarah, and she is an American woman with a young child.
(The two characters first exchange greetings.)
-Sarah: Oh, I took my baby to the nursery this morning, and guess what I saw, a kid with chickenpox! And the child rubbed his face all over me!
-Charlotte: Haha, that's not nice. Now you stay away from me!
-Sarah: Oh my god, **have you not had chickenpox before?** (strongly biased question)
-Charlotte: *(answer to be filled by participant).*
-Sarah: Then you are safe! You won't get it again.
...
(The two characters chat about childcare and then start chatting about housing)
-Sarah: We don't own our apartment and our landlord is sometimes too strict about what I can and cannot do. What about you? Do you own your apartment? **Do you not own your apartment ?** (weakly biased question)
-Charlotte: *(answer to be filled by participant).*
-Sarah: Ah that makes life easier.
...

Results: we counted answers containing the second type of "no" (the "RELATIVE" uses), for example "No, I am American", "No, I have!", "No, I've gotten it before but I was really young.". When the bias is weak, there were 5 such answers, constituting 5.2% of all answers; when the bias is strong, there were 32 such answers, constituting 32.7% of all answers. The difference is significant under a χ^2 test: $\chi^2 = 272.15$, $p < 2.2\text{e-}16$, suggesting that the strength of epistemic bias influences the licensing of the second type (the "RELATIVE" use) of "no".

5. Conclusions

The English particle "no" can be used in a variety of conversational contexts. So far, no analyses have been offered that cover all uses of "no". We propose that "no" is ambiguous with three meanings, distinguished by the type of antecedent utilized: explicit, implicit and exophoric. The second type—"no" with an implicit antecedent—addresses a grounding misalignment caused by sources such as speaker's bias. This type of "no" cannot be used bare. The current semantic theories on "no" as an answer particle to negative polar questions and assertions claim that "no" is ambiguous between confirming and rejecting the polar question or assertion. The preceding negative polar question or assertion licenses and therefore provides the content for "no" in answers like "No, I AM". We argue instead that the ambiguity arises from whether "no" picks up an explicit antecedent—the queried proposition—or an implicit one—the questioner's bias. We formalize our account in the KoS framework (Ginzburg, 2012). We offer three predictions and show that even positive antecedents with implied bias may license the "No, I AM" type of answer; in dialogue, bare "no"s only pick up explicit antecedents; the strength of the bias in a negative question influences the rate of the second type of "no" uses. Our analysis highlights the importance of potential mismatches between the information states of different conversational participants in meaning resolution.

Important future work involves a comprehensive corpus study to test the coverage of our account and for the implicit antecedent use—a characterization of how such antecedents can be detected.

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Japanese alternative questions and a unified in-situ semantics for *ka*[1]

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Abstract. In Japanese, the interpretation of a clause involving a *wh*-item and the Q-particle *ka* is conditioned by the syntactic position of *ka*. In a parallel fashion, we observe that the syntactic position of *ka* conditions the interpretation of a disjunctive construction of the form α-*ka* β-*ka*. We propose a two-tier alternative semantics for *wh+ka* and *ka*-disjunction that accounts for the parallel syntactic conditioning effect in a unified fashion.

Keywords: *ka*, Q-particle, *wh*-indefinites, *wh*-questions, disjunction, alternative semantics

1. Introduction

The goal of this paper is to provide a concrete semantics for the Japanese Q-particle *ka* that properly accounts for its use in questions, indefinites and disjunctions in a unified fashion. The Japanese particle *ka* is interesting in the context of the cross-linguistic compositional semantics of indefinites, *wh*-questions and disjunctions (Szabolcsi, 2015) since its interpretation is tightly connected with the syntactic environments in which it occurs, as will be discussed shortly below. A number of proposals have been proposed to capture this connection between the syntactic environment in which *ka* occurs and its interpretation (e.g., Hagstrom, 1998; Shimoyama, 2006; Slade, 2011). However, none of the current compositional semantic analysis of *ka* can successfully capture the fact that the semantic contribution of *ka* is conditioned by its syntactic position in its *disjunction use* in a way parallel to how its semantic contribution is conditioned in the *wh+ka* construction. This paper argues that this parallel pattern straightforwardly falls out from the combination of (a) an extension of the alternative-semantic analysis of in-situ *wh*-questions and Q-particles (Shimoyama, 2006; Beck, 2006; Kotek, 2014) and (b) the Junction-based analysis of disjunction following den Dikken (2006); Mitrovič and Sauerland (2014); Szabolcsi (2015).

2. The position of *ka* and its semantic contribution

2.1. *wh+ka*

The interpretation of a Japanese sentences involving a *wh*-item and *ka* depends on the syntactic position of *ka* (Kuroda, 1965; Hagstrom, 1998). When *ka* directly attaches to the *wh*-phrase, the *wh-ka* complex functions as an indefinite. On the other hand, when *ka* is in a sentence-final position, the sentence constitutes a *wh*-question. This can be seen in the following examples:

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(1) a. [$_{DP}$ Dare-**ka**] -ga hashitta.
who-KA -NOM ran
'Someone ran.' **(∃-statement)**

b. [$_{CP}$ Dare-ga hashitta-**ka**] (oshiete)
who-NOM ran-KA tell
'(Tell me) who ran.' **(Wh-Question)**

Here, the embedding verb *oshiete* 'tell me' is added in (1b) since the clause-final *ka* is most natural in embedded contexts for stylistic reasons. In an unembedded clause, *no* is used instead of *ka* in informal speech. In an unembedded formal speech, *ka* is attached to the polite form of the verbal complex.[2]

2.2. *ka*-disjunctions

Another empirical domain in which *ka* appears is disjunction. Example (2) shows that *ka* can attach to each disjunct in a disjunction (optionally to the second disjunct).[3] I will call this construction *ka*-DISJUNCTION.

(2) Taro-ga [$_{DP}$ Hanako-**ka** (matawa) Jiro-**ka**]-o mita.
Taro-NOM Hanako-KA or Jiro-KA-ACC saw.
'Taro saw Hanako or Jiro.' **(∨-statement)**

An additional coordinator (in this case *matawa*) can be inserted between the two disjuncts marked by *ka*, and there are several phonologically explicit disjunctive coordinators with different syntactic and semantic properties. In this paper, I will leave out discussion of *ka*-disjunctions involving an explicit coordinator for reasons of space.

One of the empirical contributions of this paper is to establish that the interpretation of a *ka*-disjunction is dependent on the syntactic position of *ka* in each disjunct, in a way parallel to how the interpretation of a *wh*+*ka* construction is dependent on the syntactic position of *ka*. The parallel is summarized in the following table.

[2] For some speakers, the *wh*-item and *ka* can be separated within a DP that functions as an indefinite. The following example from Yatsushiro (2009) illustrates this:

(1) [Dare-o hihanshita gakusei]-**ka**-ga taihosareta.
who-ACC criticized student -KA-NOM be.arrested.
'A student or other who had criticize someone was arrested'

In this example, *ka* is separated from the *wh*-item *dare* itself, and the who subject DP ending with *ka* receives an interpretation as an existential quantifier over students who criticized someone.

[3] I will assume that the presence and the absence of the second *ka* does not have a semantic consequence, unlike the contrast between simplex and complex disjunctions in French (e.g., Spector, 2014). This is confirmed by informal judgment reports by native speakers. Furthermore, a controlled experiment by Sauerland and Yatsushiro (2016) has not revealed any significant difference in judgment patterns between the single-*ka* and the double-*ka* disjunctions.

(3)

the *ka*-phrase is...	**smaller than a CP**	**CP**
wh+ka	existential quantifier	*wh*-question
α-*ka* β-*ka*	declarative disjunction	alternative question

Let me elaborate this empirical claim in some detail. First of all, the dependence of the interpretation of *wh+ka* on the syntactic position of *ka*, exemplified in (1) above, can be described as in the first row of table (3). The syntactic category of the *wh+ka* phrase is a *DP* in (1a), where *ka* attaches to the *wh*-phrase *dare* directly and *dare-ka* serves as the external argument of the verb *hashitta* 'ran'. This *wh-ka* phrase functions as an indefinite/existential quantifier. On the other hand, the *wh+ka* phrase in (1b) is a whole CP which by itself expresses a question (modulo stylistic anomaly) and can be embedded under clause-embedding predicates such as *oshiete* 'tell me'. In this case, the *wh*-phrase functions as a *wh*-word in a *wh*-question.

Turning now to *ka*-disjunctions, it is known that *ka*-disjunctions can coordinate (at least) DPs, TPs as well as CPs (Kishimoto, 2013; Uegaki, 2014; Miyama, 2015).[4]

(4) [$_{\text{DP}}$ Hanako-ka Jiro-ka]-ga hashitta.
Hanako-KA Jiro-KA-NOM ran.
'Either Hanako or Jiro ran'. **(✓∨-statement)**
*'Which is true: Hanako ran or Jiro ran?' **(*AltQ)**

(5) [$_{\text{TP}}$ [Hanako-ga hashitta-**ka**] [Jiro-ga hashitta-**ka**]] mitai-da.
Hanako-NOM ran-KA Jiro-NOM ran-KA MODAL-COP
'It seems that Hanako ran or Jiro ran.' **(✓∨-statement)**
*'Which seems to be true: Hanako ran or Jiro ran?' **(*AltQ)**

(6) [$_{\text{CP}}$ [Hanako-ga hashitta-mitai-**ka**] [Jiro-ga hashitta-mitai-**ka**]] (oshiete).
Hanako-NOM ran-MOOD-KA Jiro-NOM ran-MOOD-KA tell
'(Tell me) which is true: It seems that Hanako ran or it seems that Jiro ran?' **(✓AltQ)**
*'(Tell me) it seems that Hanako ran or it seems that Jiro ran.' **(*∨-statement)**

Following Kishimoto (2013), I take the positioning of a modal such as *mitai* 'seem', which is in a functional projection outside TP, as indicating the syntactic category of *ka*-disjunctions. When the modal is outside the *ka*-disjunction involving tensed predicates, as in (5), its syntactic category is TP. On the other hand, when the modal is inside the *ka*-disjunction, as in (6), or when there is no overt modal item in the sentence as in (7) below, its syntactic category is CP.

(7) [$_{\text{CP}}$ [Hanako-ga hashitta-**ka**] [Jiro-ga hashitta-**ka**]] oshiete.
Hanako-NOM ran-KA Jiro-NOM ran-KA tell
'Tell me which is true: Hanako ran or Jiro ran?' **(✓AltQ)**

[4] Kishimoto (2013) discusses cases where *ka*-disjunctions apparently coordinate vPs in the surface, but he concludes that they are in fact TP disjunctions based on evidence pertaining to scope with respect to negation.

What is crucial here is that the interpretation of a *ka*-disjunction is a disjunctive statement in both (4) and (5) whereas it is an AltQ in (6) and (7). In other words, α-*ka* β-*ka* becomes a question with α and β as alternatives only when it is a CP coordination (Uegaki, 2014).

In sum, *ka*-disjunctions are interpreted as disjunctions without the question force when they are sub-CP-coordinations while they are interpreted as AltQs with each disjunct as alternatives when they are CP-coordinations. This parallels the behavior of *wh+ka* constructions as summarized in the table in (3).

3. An analysis in a two-tier alternative semantics

Our proposal employs two-tier alternative semantics (Rooth, 1985) for in-situ *wh*-questions (Beck, 2006; Kotek, 2014). The gist of the analysis is the following: *ka* introduces *a set of alternatives* in its ordinary-semantic value, but only specific predicates—which I will call SET-COMPATIBLE PREDICATES—semantically combine with such a set. Set-compatible predicates include predicates embedding interrogative CPs, such as *oshier* 'tell', and the disjunctive coordinator. As a result, a semantic composition of a *ka*-phrase and a set-incompatible predicate requires that the set denoted by the former be 'flattened' into an *existential meaning*. This is what happens when *ka* is introduced below CPs. A predicate or operator embedding a *ka*-phrase below the CP level is always set-incompatible except for the disjunctive coordinator. Thus, when *ka*-phrases are smaller than CPs, they are 'trapped' inside a non-incompatible predicate and receive an existential meaning. Formally, the flattening effect is implemented with a cross-categorial existential closure ∃.

3.1. *wh+ka*

Below, I illustrate this system using a simple fragment that captures the basic data discussed in the previous section. First, let us consider the case of the *wh+ka* construction, repeated below.

(1) a. [$_{\text{DP}}$ dare-**ka**]-ga hashitta.
who-KA-NOM ran.
'Someone ran.' **(∃-statement)**

b. [$_{\text{CP}}$ dare-ga hashitta-**ka**]
who-NOM ran-KA
'(Tell me) who ran?' **(Wh-Question)**

In the two-tier alternative-semantic analysis of in-situ *wh*-questions developed by Beck (2006) and Kotek (2014), lexical items have ORDINARY and ALTERNATIVE-SEMANTIC VALUES (hereafter O-VALUES and ALT-VALUES). For instance, the semantic values of *ka*, *dare* 'who' and *hashitta* 'ran' each look like the following:

(8) a. $[\![\alpha \text{ ka}]\!]^o = [\![\alpha]\!]^{alt}$ b. $[\![\alpha \text{ ka}]\!]^{alt} = \{[\![\alpha]\!]^{alt}\}$

(9) a. $[\![\text{dare}]\!]^o$ = undefined   b. $[\![\text{dare}]\!]^{alt} = \{x \mid x \in \textbf{human}\}$

(10) a. $[\![\text{hashitta}]\!]^{o} = \lambda x_{\mathtt{e}}\lambda w_{\mathtt{s}}.\mathbf{ran}(x,w)$ b. $[\![\text{hashitta}]\!]^{alt} = \{\lambda x_{\mathtt{e}}\lambda w_{\mathtt{s}}.\mathbf{ran}(x,w)\}$

Here, *ka* is defined as an operator that simply 'copies' the alt-value of its prejacent to the o-value. A *wh*-item like *dare* has an undefined o-value while it introduces a set of alternatives in the alt-value. A set-incompatible predicate like *hashitta* has a standard denotation as a function from individuals to truth values in the o-value while its alt-value is the singleton set consisting of the o-value.

Except for *ka*, which has a syncategorematic definition, semantic values are composed according to either one of the following two rules:

(11) a. **Functional Application (FA)**
If the node α has $\{\beta,\gamma\}$ as the set of its daughters and $[\![\beta]\!]^{o} \in D_{\sigma}$ and $[\![\gamma]\!]^{o} \in D_{\langle\sigma,\tau\rangle}$, then $[\![\alpha]\!]^{o}$ is defined only if both $[\![\alpha]\!]^{o}$ and $[\![\beta]\!]^{o}$ are. In this case, $[\![\alpha]\!]^{o} = [\![\gamma]\!]^{o}([\![\beta]\!]^{o})$.

b. **Point-wise Functional Application (PWFA)** (Hamblin, 1973)
If the node α has $\{\beta,\gamma\}$ as the set of its daughters and $[\![\beta]\!]^{alt} \subseteq D_{\sigma}$ and $[\![\gamma]\!]^{alt} \subseteq D_{\langle\sigma,\tau\rangle}$, then $[\![\alpha]\!]^{alt} = \{\, a \mid \exists f \in [\![\gamma]\!]^{alt} \exists b \in [\![\beta]\!]^{alt} [a = f(b)]\,\}$.

3.1.1. *Wh*-questions

Given this setup adopted from Beck (2006) and Kotek (2014),[5] we can already account for the interpretation of the *wh*-question in (1b). Below is a simplified LF tree for (1b) with annotation of the two kinds of semantic values for each node. The notation $\langle a,b\rangle$ indicates that the node's o-value is a while its alt-value is b.

(12)

$\left\langle \begin{array}{c}\{\,\lambda w_{\mathtt{s}}.\mathbf{ran}(x,w) \mid x \in \mathbf{human}\,\},\\ \{\{\,\lambda w_{\mathtt{s}}.\mathbf{ran}(x,w) \mid x \in \mathbf{human}\,\}\}\end{array}\right\rangle$

- $\left\langle \begin{array}{c}\text{undefined},\\ \{\,\lambda w_{\mathtt{s}}.\mathbf{ran}(x,w) \mid x \in \mathbf{human}\,\}\end{array}\right\rangle$
  - *dare* $\left\langle \begin{array}{c}\text{undefined},\\ \{\,x \mid x \in \mathbf{human}\,\}\end{array}\right\rangle$
  - *hashitta* $\left\langle \begin{array}{c}\lambda x_{\mathtt{e}}\lambda w_{\mathtt{s}}.\mathbf{ran}(x,w),\\ \{\,\lambda x_{\mathtt{e}}\lambda w_{\mathtt{s}}.\mathbf{ran}(x,w)\,\}\end{array}\right\rangle$
- *ka*

What is crucial above is that the alternatives introduced by *dare* is passed up via an application of PWFA in the alternative-semantic dimension, until the top-level *ka* returns it as the o-value (Beck, 2006). As a result, the sentence receives the standard proposition-set denotation for *wh*-questions (Hamblin, 1973; Karttunen, 1977) as its o-value.

[5]More precisely, I here adopt Kotek's (2014) definition of the Q-particle, instead of that by Beck (2006), who defines the alt-value of α *ka* as equivalent to its o-value. See Kotek (2014) for independent motivations for adopting this particular definition in relation to the treatment of multiple *wh*-questions in English. For the purpose of this paper, adopting Kotek's (2014) definition enables a simpler compositional system.

3.1.2. Excursus: Yes/No-questions and the semantics of complementizers

It is important to note at this point that *ka* defined in (8) is also the one that appears as the sentence-final particle in Yes/No-questions (YNQs), as exemplified in (13). The analysis predicts the following o-value for (13) in (14).

(13) Hanako-ga hashitta-ka?
Hanako-NOM ran-KA
'Did Hanako run?'

(14) $[\![(13)]\!]^o = \{\lambda w.\mathbf{ran}(\mathbf{h}, w)\}$

The singleton-set denotation for YNQs as exemplified above is different from the more standard bipolar denotation (Hamblin, 1973; Karttunen, 1977), which would be the following two-membered set in the case of (13).

(15) $\{\lambda w.\mathbf{ran}(\mathbf{h}, w), \lambda w.\neg\mathbf{ran}(\mathbf{h}, w)\}$

Versions of the singleton analysis of the semantics of YNQs are maintained by authors such as Roberts (2012); Pruitt and Roelofsen (2011); Biezma and Rawlins (2012); Roelofsen and Farkas (2015), and its empirical motivations come from biased polar questions, the interpretation of response particles and the selectional property of dubitative predicates, among others. In many of these analyses, the singleton denotation is mapped to the corresponding bipolar denotation by an extra operation in order to capture the fact that polar questions license negative responses. In this paper, I follow Roelofsen and Farkas (2015) in positing an interrogative operator $\langle ? \rangle$ on the top of *ka* in interrogative clauses, whose role is to *ensure* multiplicity of alternatives. Syntactically, I will assume that $\langle ? \rangle$ is in the complementizer position, above *ka*. The semantics of this operator looks like the following:

(16) $[\![\langle ? \rangle]\!]^o = [\![\mathrm{C_{int}}]\!]^o = \lambda Q_{\{\mathtt{p}\}}.\begin{cases} Q & \text{if } |Q| > 1 \\ Q \cup \{\neg \bigcup Q\} & \text{if } |Q| = 1 \end{cases}$

Applying this operator to (13), we get the bipolar denotation: $\{\lambda w.\mathbf{ran}(\mathbf{h}, w), \lambda w.\neg\mathbf{ran}(\mathbf{h}, w)\}$ The operator does not have an effect when it applies to *wh*-questions that already involve multiple alternatives. Type-wise, $\langle ? \rangle$ can only combine with a set of propositions. On the other hand, when a complement clause is declarative, the declarative operator is in the complementizer position, which is semantically an identity function for propositions. The declarative complementizer is realized as *to* in an embedded clause while it is phonologically null in the matrix clause. That is, $[\![\mathrm{C_{decl}}]\!]^o = \lambda p_{\mathtt{p}}.p$

3.1.3. Indefinites

Let us now turn to how we derive the existential statement in (1a). The first thing to note is that, without any additional mechanisms, the semantic composition does not go through due to type-mismatch. This is so since neither FA nor PWFA can combine the semantic values of *hashitta* with the semantic values of *dare-ka*. This is seen in the following uninterpretable LF.

(17)

???

$\left\langle \begin{array}{c} \{x \mid x \in \textbf{human}\}, \\ \{\{x \mid x \in \textbf{human}\}\} \end{array} \right\rangle$

dare $\left\langle \begin{array}{c} \text{undefined}, \\ \{x \mid x \in \textbf{human}\} \end{array} \right\rangle$ ka

hashitta $\left\langle \begin{array}{c} \lambda x_{\mathtt{e}} \lambda w_{\mathtt{s}}.\textbf{ran}(x,w), \\ \{\lambda x_{\mathtt{e}} \lambda w_{\mathtt{s}}.\textbf{ran}(x,w)\} \end{array} \right\rangle$

Here, the operation of existential closure that I mentioned above comes into play. Specifically, I propose that there is a following operator that turns a set in the o-value dimension into the corresponding existential quantifier.[6]

(18) a. $[\![\exists]\!]^o = \lambda Q_{\{\sigma\}} \begin{cases} \lambda w_{\mathtt{s}}.\exists p \in Q[p(w)] & \text{if } \sigma = \mathtt{p} \\ \lambda P_{\langle \sigma, \mathtt{p} \rangle} \lambda w_{\mathtt{s}}.\exists x \in Q[P(x)(w)] & \text{otherwise} \end{cases}$ $(\mathtt{p} := \langle \mathtt{s}, \mathtt{t} \rangle)$

b. $[\![\exists]\!]^{alt} = \{[\![\exists]\!]^o\}$

c. σ is any type, and $\{\sigma\}$ is the type for the set of σ-type objects. I assume a formal distinction between sets and characteristic functions. Thus, $\{\sigma\}$ is a distinct type from $\langle \sigma, \mathtt{t} \rangle$.[7]

This operator can be applied to *dare-ka* in (17). As a result, we derive the existential statement as in the following LF:

(19)

$\left\langle \begin{array}{c} \lambda w.\exists x \in \textbf{human}[\textbf{ran}(x,w)], \\ \{\lambda w.\exists x \in \textbf{human}[\textbf{ran}(x,w)]\} \end{array} \right\rangle$

$\left\langle \begin{array}{c} \lambda P_{\langle \mathtt{e},\mathtt{p} \rangle} \lambda w.\exists x \in \textbf{human}[P(x,w)], \\ \{\lambda P_{\langle \mathtt{e},\mathtt{p} \rangle} \lambda w.\exists x \in \textbf{human}[P(x,w)]\} \end{array} \right\rangle$

$\left\langle \begin{array}{c} \{x \mid x \in \textbf{human}\}, \\ \{\{x \mid x \in \textbf{human}\}\} \end{array} \right\rangle$

dare $\left\langle \begin{array}{c} \text{undefined}, \\ \{x \mid x \in \textbf{human}\} \end{array} \right\rangle$ ka

$\exists$ $\left\langle \begin{array}{c} \lambda Q_{\{\mathtt{e}\}} \lambda P_{\langle \mathtt{e},\mathtt{p} \rangle} \lambda w.\exists x \in Q[P(x,w)], \\ \{\lambda Q_{\{\mathtt{e}\}} \lambda P_{\langle \mathtt{e},\mathtt{p} \rangle} \lambda w.\exists x \in Q[P(x,w)]\} \end{array} \right\rangle$

hashitta $\left\langle \begin{array}{c} \lambda x_{\mathtt{e}} \lambda w_{\mathtt{s}}.\textbf{ran}(x,w), \\ \{\lambda x_{\mathtt{e}} \lambda w_{\mathtt{s}}.\textbf{ran}(x,w)\} \end{array} \right\rangle$

Thus, we can capture the fact that (1a) is an existential statement rather than a *wh*-question. The only way in which the semantic composition of *dare-ka* 'who-KA' and *hashitta* 'ran' goes through is to turn the the o-value of the former into an existential quantifier by $\exists$. The same mechanism applies to other cases where a non-inquisitive predicate combine with a *ka*-phrase.

[6]The operation of existential closure is employed in alternative semantics by Kratzer and Shimoyama (2002) and Biezma and Rawlins (2012) (among others) although the operation always applies at the clausal level. Here, $\exists$ is defined as a cross-categorial operator which can apply clause-internally. In this sense, the operation is close to the non-inquisitive closure ! in Inquisitive Semantics (Ciardelli et al., 2013).

[7]Yatsushiro (2009) uses the notation $\langle \sigma \backslash t \rangle$ to denote the same type.

Note, however, that the introduction of $\exists$ creates a potential problem. The *wh*-question interpretation of (1b) itself could now be turned into an existential statement if $\exists$ is freely available and applied to the whole sentence. However, it is plausible to assume that an operator like $\exists$ is *not* freely available. I claim that the application of $\exists$ is allowed only when it is necessary for the semantic composition to go through, as stated in the following constraint:

(20) The application of $\exists$ is allowed only as a repair of a type-mismatch.

This constraint prohibits the application of $\exists$ to the whole sentence of (1b). Since LF (12) of (1b) does not suffer from any type-mismatch, the application of $\exists$ is disallowed. Hence, the sentence lacks an interpretation as the existential statement.

This is true also when (1b) is embedded under question-embedding predicates since there would be no type-mismatch between question-embedding predicates and (1b). I analyze all question-embedding predicates as a set-compatible predicate, i.e., as selecting for a set of propositions, both in the o-value and in the alt-value. For instance, the semantic values of *oshier(u)* 'tell/teach' look like the following:

(21) a. $[\![\text{oshier}]\!]^{o} = \lambda Q_{\{\mathtt{p}\}}\lambda x\lambda w.\mathbf{tell}(x,Q,w)$ b. $[\![\text{oshier}]\!]^{alt} = \{\lambda Q_{\{\mathtt{p}\}}\lambda x\lambda w.\mathbf{tell}(x,Q,w)\}$

Thus, the set of propositions in the o-value and the alt-value of an interrogative CP can be combined with the question-embedding predicate via FA and PWFA. Hence, there is no type-mismatch and the existential closure by $\exists$ does not occur. I claim that there is no set-compatible predicate in Japanese other than interrogative-CP-embedding predicates like (21), disjunctive coordinators such as the disjunctive coordinator and $\exists$ itself. Thus, any case in which a *ka*-phrase combines with items other than these operators at LF involves existential closure.

This system captures the fact that the position of *ka* conditions the interpretation of a *wh+ka* construction, as we saw in the previous section. When the *ka*-phrase together with C_{int} forms a whole CP, it would receive the interpretation as the set of propositions, i.e., a question, whether or not it is embedded by a question-embedding predicate. This is because there would be no type-mismatch in the semantic composition. On the other hand, when the *ka*-phrase forms a DP, the set of alternatives it denotes in the o-value cannot participate in the semantic composition unless it is flattened into a non-set. Because, as I claimed above, there is no set-compatible predicate that can syntactically combine with a DP, except for disjunctive coordinators, which I turn to in the next section.

3.2. *ka*-disjunctions

In this section, I will argue that the generalization about the effect of the position of *ka* on the interpretation of *ka*-disjunctions can be captured as a natural extension of the system outlined above, once we take into account an appropriate syntax for disjunctions. Following the structure of complex coordinations adopted in the literature on the cross-linguistic syntax and semantics of coordinations (den Dikken, 2006; Slade, 2011; Mitrovič and Sauerland, 2014; Szabolcsi, 2015), I assume that *ka*-disjunctions involve a Junction head (hereafter J) with *ka*-phrases both in its internal argument position and in the specifier. The structure is schematized as follows:

(22) $[_{\text{JP}}\ [_{\text{XP}}\ \alpha$ ka$]\ [_{\text{J}'}$ J $[_{\text{XP}}\ \alpha$ ka$]]]$

The disjunctive J head is realized either as *matawa* or *soretomo*, or is phonologically null. I treat disjunctive J as denoting the set-union operation in the o-value, as given in (23a) below, while its alt-value is defined in terms of generalized disjunction (Partee and Rooth, 1983).

(23) a. $[\![\text{J}]\!]^o = \lambda X_{\{\sigma\}}\lambda Y_{\{\sigma\}}.X \cup Y$ b. $[\![\text{J}]\!]^{alt} = \{\lambda X_{\{\sigma\}}\lambda Y_{\{\sigma\}}.\{\iota X \sqcup \iota Y\}\}$[8]

b. ιX is defined only if X is a singleton set. If defined, ιX is the unique member of X.

c. $X \sqcup Y = \begin{cases} X \vee Y & \text{if } X \text{ and } Y \text{ are of type } \mathtt{t} \\ \lambda Z_\sigma.X(Z) \vee Y(Z) & \text{if } X \text{ and } Y \text{ are of type } \langle\sigma,\mathtt{t}\rangle \end{cases}$

As concrete examples, we have the following semantic derivations of two examples of *ka*-disjunctions: the DP disjunction *Hanako-ka Jiro-ka* and the clausal disjunction *Hanako-ga hashitta-ka Jiro-ga hashitta-ka*. As one can see from the following LFs, the analysis derives two-membered sets consisting of (the o-values of) its disjuncts (i.e., α and β in the schema in (22)) as the semantic values of a *ka*-disjunction as a whole.[9]

(24) a. $[\![$[Hanako-ka [∅ Jiro-ka]]$]\!]^o = \{\lambda P.P(\mathbf{j}), \lambda P.P(\mathbf{h})\}$
$[\![$[Hanako-ka [∅ Jiro-ka]]$]\!]^{alt} = \{\{\lambda P.P(\mathbf{j}) \vee P(\mathbf{h})\}\}$

b. $[\![$[[H.-ga hashitta] ka] [∅ [[J.-ga hashitta] ka]]$]\!]^o = \{\lambda w.\mathbf{ran}(\mathbf{j},w), \lambda w.\mathbf{ran}(\mathbf{h},w)\}$
$[\![$[[H.-ga hashitta] ka] [∅ [[J.-ga hashitta] ka]]$]\!]^{alt} = \{\{\lambda w.\mathbf{ran}(\mathbf{j},w) \vee \mathbf{ran}(\mathbf{h},w)\}\}$

We have now already accounted for the AltQ interpretation for clausal *ka*-disjunctions. As can be seen in (24b), a clausal *ka*-disjunction receives as its o-value a set of two propositions, each contributed by the clausal disjuncts. This is precisely the standard semantic denotation for AltQs (Karttunen, 1977; Biezma and Rawlins, 2012).[10] In other words, the AltQ interpretation is analyzed as the union of the singleton interpretations of the question nucleus of two YNQs (Uegaki, 2014). Similar analyses of AltQs are maintained by Pruitt and Roelofsen (2011) for English, Gračanin-Yuksek (2014) for Turkish and Mayr and Zuchewicz (2015) for Polish.

[8]The alt-value of J is defined this way so that the alternatives in the alt-value do not involve the same alternatives as in the o-value, but rather are 'reset' to a singleton. This is empirically necessary because clause-final *ka* above a *ka*-disjunction cannot project an alternative question, but rather an Y/N-question:

(i) [Hanako-**ka** Jiro-**ka**]-ga hashitta-**ka** oshiete.
Hanako-KA Jiro-KA -NOM ran-KA tell.
'Tell me whether or not either Hanako or Jiro ran' (Y/NQ)

[9]I assume that a type-lifting from type σ to type $\langle\langle\sigma,\mathrm{p}\rangle,\mathrm{p}\rangle$ is available. The type-lifting applies to the denotations of *Hanako* and *Jiro* in (24a) for them to be coordinated by ∅ (Partee and Rooth, 1983).

[10]I assume that the exclusivity presupposition of AltQs—the presupposition that only one of the alternatives is true—is guaranteed by an additional operator, following Pruitt and Roelofsen (2011) and Biezma and Rawlins (2012). In the current setup, it can be added to the contribution of ⟨?⟩, introduced in (16).

Furthermore, given the mechanism of semantic composition and the repair of the type-mismatch in terms of $\exists$ described in the previous section, we can also account for the fact that *ka*-disjunctions syntactically smaller than the complement of C[11] end up receiving an existential/declarative disjunctive interpretation. The explanation is exactly parallel to that of the existential interpretation of *wh+ka*. When a *ka*-disjunction is smaller than the complement of C, it has to be semantically combined with a sub-CP predicate/operator. Given the assumption that any such sub-CP operator (other than the J head and $\exists$) is set-incompatible, the o-value of a *ka*-disjunction cannot be directly combined with them. It would result in a type-mismatch.

For example, when the DP-disjunction in (24a) appears in a sentence such as the following repeated from the previous section, $\exists$ repairs the type-mismatch between the disjunction and the verb *hashitta*, as shown in (25).

(4) [$_{\text{DP}}$ Hanako-ka Jiro-ka]-ga hashitta.
Hanako-KA Jiro-KA-NOM ran.
'Either Hanako or Jiro ran'.

(25) a. $[\![$[[Hanako-ka $\varnothing$ Jiro-ka] $\exists$] hashitta$]\!]^{o} = \lambda w.\mathbf{ran}(\mathbf{j},w) \vee \mathbf{ran}(\mathbf{h},w)$
b. $[\![$[[Hanako-ka $\varnothing$ Jiro-ka] $\exists$] hashitta$]\!]^{alt} = \{\lambda w.\mathbf{ran}(\mathbf{j},w) \vee \mathbf{ran}(\mathbf{h},w)\}$

4. Existential closure at the clausal level

One of the predictions of the analysis developed so far is that clauses ending with *ka* would receive an existential meaning under proposition-embedding predicates, as the existential closure would kick in to rescue the type-mismatch. In fact, this is not what we see empirically. Clauses ending with *ka* are generally ungrammatical under proposition-embedding predicates like *shinjiru* 'believe' and *mitai* 'seem'. In this section, I will detail the data of *ka*-ending clauses embedded under proposition-embedding predicates, and offer an explanation of the pattern based on independent reasons. I will also point out grammatical examples of embedded *ka*-clauses which have existential interpretations in the way predicted by the current analysis.

The analysis presented up to this point has problems with the following examples, where clauses (specifically CPs and TPs) ending with *ka* are embedded under the proposition-taking predicates *shinjiteiru* 'believe' and *mitai(-da)* 'seem'. The sentences are ungrammatical although the analysis predicts an existential interpretation of the complements.[12]

[11] Here, I say 'complement of C' instead of 'CP' because I assume the existence of the complementizer above a clausal JP (see Section 3.1.2). That is, a clausal JP would have the following structure in an interrogative CP.

(i) [$_{\text{CP}}$ [$_{\text{JP}}$ [α-ka] [J [β-ka]]] $\langle ? \rangle$]

[12] The exact location of the existential closure in (26a) would be different depending on the type of the complementizer. If the complementizer is the declarative complementizer *to*, it would be applied right below the complementizer since it denotes the identity function over propositions (see Section 3.1.2). On the other hand, if the complementizer is the interrogative complementizer $\langle ? \rangle$ defined in (16), the existential closure would be applied right above the complementizer. Either way, the predicted meaning would be equivalent to that of (27a), modulo the existential presupposition for the latter case, which will be discussed below.

(26) a. *Hanako-wa [dare-ga hashitta-**ka** (da) -to/⟨?⟩] shinjiteiru.
Hanako-TOP who-NOM ran-KA COP $\text{COMP}_{\text{DECL}}$/$\text{COMP}_{\text{INT}}$ believe
Intended: 'Hanako believes that someone ran.'

b. * [dare-ga hashitta-**ka**] mitai da.
who-NOM ran-KA seem COP
Intended: 'It seems that someone ran.'

What makes the problem puzzling is the fact that the following sentence is grammatical with the same existential interpretation as predicted for (26a).

(27) a. Hanako-wa [dare-**ka**-ga hashitta-to] shinjiteiru.
Hanako-TOP who-KA-NOM ran-$\text{COMP}_{\text{DECL}}$ believe
'Hanako believes that someone ran.'

b. [dare-**ka**-ga hashitta] mitai da.
who-NOM ran-KA seem COP
'It seems that someone ran.'

The only difference would be when the existential closure is applied. In (27a), it is at the DP level while in (26a), it is at the CP/TP level.

4.1. A blocking-based account

Despite the appearance of the problem, the ungrammaticality of existential closure at the clausal level in (26) receives a natural explanation in terms of BLOCKING (Aronoff, 1976). The notion of blocking in morphology is employed to account for a lack of certain form in a paradigm, when there is a more optimal competing synonymous form. For example, the form **badder* is ungrammatical insofar as it would mean the same thing as *worse*, because it is blocked by the more optimal competitor *worse* (Kiparsky, 2004). The notion of blocking is extended to syntax and semantics by Atlas and Levinson (1981); Horn (1984) and Blutner (2000), and applied to empirical domains such as the interpretation of lexical and periphrastic causation (McCawley, 1978), pronominal reference and presupposition projection. The general idea in these applications of blocking is the same as that of blocking in morphology: a form is blocked if there is another form with the equivalent interpretation that can be achieved more economically, either from rational pragmatic perspectives or processing perspectives. This idea is formulated in terms of neo-Gricean pragmatics by Atlas and Levinson (1981); Horn (1984) and in terms of bi-directional OT by Blutner (2000).

I propose that a similar account can be made for the badness of (26): they are blocked by the corresponding competitors in (27). The additional claim behind this proposal is that the forms in which *ka* locally attaches to a *wh*-item, such as (27), are more economical than the corresponding forms in which *ka* attaches to a clause, such as (26). The rationale for this claim is the following: when *ka* directly attaches to a *wh*-item, the syntactic and semantic features of the *ka*-ending DP itself guarantee that it has to be existentially closed since such forms cannot be in an argument position of set-compatible predicates.[13] On the other hand, the features of a *ka*-ending clause itself do not determine if it has to be existentially closed or not. Whether it has to be existentially closed depends on the presence and absence of an embedding set-incompatible predicate. In this sense, a *ka*-ending DP is by itself essentially disambiguated into an existential interpretation while a *ka*-ending clause is itself ambiguous. Given that existence of local ambiguity in a sentence leads to processing cost and danger of miscommunication even when the form is ultimately disambiguated ('garden-path' effect; Bever 1970), we can conclude that the forms involving CP-*ka* count as more costly than the forms involving DP-*ka* for the purpose of blocking. Thus, theories of blocking extended to syntactic forms as mentioned above would account for the badness of (26) as a result of blocking from (27).

4.2. Clause-level existential quantification in CP adjuncts

This analysis makes a crucial prediction due to the fact that the mechanism of blocking relies on the existence of a semantically equivalent competitor. That is, the existential closure at the clausal level would be allowed if the resulting interpretation cannot be derived from a simpler competitor. In this section, I will provide data showing that this prediction is borne out. The relevant examples involve CP adjuncts, such as the following:

(28) a. [Dare-ga kita-kara-**ka**] Taro-wa yorokondeita.
who-NOM came-because-KA Taro-TOP was.happy
'For some person *x*, because *x* came, Taro was happy.' ('because'-clause)

b. [Dare-ni au-tame-**ka**] Taro-wa hayaku daigaku-ni kita.
who-DAT meet-in.order.to-KA Taro-TOP early university-GOAL came.
'For some person *x*, to meet *x*, Taro came.' (purpose-clause)

The interpretations of these examples are derived from the application of the existential closure to the whole adjunct CP. The existential closure is triggered by the fact that the coordinators *kara* 'because' and *tame* 'in order to' denote relations between two propositions (of type $\langle \mathrm{p}, \langle \mathrm{p}, \mathrm{p} \rangle \rangle$); the adjunct CPs ending with *ka* would denote a type $\{\langle \mathrm{p}, \mathrm{p} \rangle\}$ object, which is incompatible with the propositional main clause. This type-mismatch is resolved by applying the existential closure to the adjunct CPs. The following LF tree illustrates the derivation of the *ka*-ending *because*-clause in (28a), together with the existential closure.

[13]This can be further argued for as follows: Syntactically, since a *wh-ka* phrase has the distribution of DPs, it cannot appear as the clausal complement of CP-embedding predicates. Furthermore, since *wh-ka* denotes non-singletons, it cannot be combined with the disjunctive coordinators ∅. It is only CP-embedding predicates and disjunctive coordinators that are set-compatible. Hence, a *wh-ka* phrase can only combine with set-incompatible predicates. Moreover, although some set-compatible CP-embedding predicates can be combined with DPs under a Concealed Question interpretation (e.g., *wakaru*, 'figure out'; Baker 1968), a *wh-ka* phrase would merely denote a set of individuals in the domain of the *wh*-item, which would not warrant a concealed question interpretation under theories of concealed questions (Heim, 1979; Frana, 2010; Aloni and Roelofsen, 2011).

(29)

$$\left\langle \begin{array}{c} \lambda P_{\langle\langle \mathrm{p},\mathrm{p}\rangle,\mathrm{p}\rangle}\lambda w''.\exists f \in \{\,\lambda q_{\mathrm{p}}\lambda w.\mathbf{because}(q,\lambda w'.\mathbf{came}(x,w'),w) \mid x \in \mathbf{hum}\,\}[P(f)(w'')] \\ \{\lambda P_{\langle\langle \mathrm{p},\mathrm{p}\rangle,\mathrm{p}\rangle}\lambda w''.\exists f \in \{\,\lambda q_{\mathrm{p}}\lambda w.\mathbf{because}(q,\lambda w'.\mathbf{came}(x,w'),w) \mid x \in \mathbf{hum}\,\}[P(f)(w'')]\} \end{array} \right\rangle$$

$$\left\langle \begin{array}{c} \{\,\lambda q_{\mathrm{p}}\lambda w.\mathbf{because}(q,\lambda w'.\mathbf{came}(x,w'),w) \mid x \in \mathbf{hum}\,\} \\ \{\,\lambda q_{\mathrm{p}}\lambda w.\mathbf{because}(q,\lambda w'.\mathbf{came}(x,w'),w) \mid x \in \mathbf{hum}\,\} \end{array} \right\rangle \qquad \exists$$

$$\left\langle \begin{array}{c} \varnothing \\ \{\,\lambda q_{\mathrm{p}}\lambda w.\mathbf{because}(q,\lambda w'.\mathbf{came}(x,w'),w) \mid x \in \mathbf{hum}\,\} \end{array} \right\rangle \qquad \text{ka}$$

$$\left\langle \begin{array}{c} \varnothing, \\ \{\,\lambda w.\mathbf{came}(x,w) \mid x \in \mathbf{hum}\,\}\} \end{array} \right\rangle \qquad \begin{array}{c} \text{kara} \\ \left\langle \begin{array}{c} \lambda p_{\mathrm{p}}\lambda q_{\mathrm{p}}\lambda w.\mathbf{because}(q,p,w) \\ \{\lambda p_{\mathrm{p}}\lambda q_{\mathrm{p}}\lambda w.\mathbf{because}(q,p,w)\} \end{array} \right\rangle \end{array}$$

dare-ga hashitta

These meanings are combined with the type-lifted meaning of the main clause in the following:

(30) a. $[\![\text{Taro-wa yorokon-deita}]\!]^{o} = \lambda g_{\langle \mathrm{p},\mathrm{p}\rangle}\lambda w.g(\lambda w'.\mathbf{happy}(\mathbf{t},w'))(w)$

b. $[\![\text{Taro-wa yorokon-deita}]\!]^{alt} = \{\lambda g_{\langle \mathrm{p},\mathrm{p}\rangle}\lambda w.g(\lambda w'.\mathbf{happy}(\mathbf{t},w'))(w)\}$

(31) a. $[\![(28a)]\!]^{o} = \lambda w.\exists f \in$
$\{\,\lambda q_{\mathrm{p}}\lambda w.\mathbf{because}(\lambda w'.\mathbf{came}(x,w'),p,w) \mid x \in \mathbf{hum}\,\}[f(\lambda w''.\mathbf{happy}(\mathbf{t},w''))(w)]$
$= \lambda w.\exists x \in \mathbf{hum}[\mathbf{because}(\lambda w''.\mathbf{happy}(\mathbf{t},w''),\lambda w'.\mathbf{came}(x,w'),w)]$

b. $[\![(28a)]\!]^{o} = \{\,\lambda w.\exists x \in \mathbf{hum}[\mathbf{because}(\lambda w''.\mathbf{happy}(\mathbf{t},w''),\lambda w'.\mathbf{came}(x,w'),w)]\,\}$

Why is the existential closure at the CP-level in (28) allowed unlike the *ka*-ending *wh*-clauses under *believe*? In fact, the grammaticality of (28) is exactly what is predicted by the blocking account. Their variants with the alternative form *dare-ka*, as in (32), do *not* have the same interpretations as (28). The relevant coordinators 'believe' and 'in order to' take scope below the existential in (28) while they take scope above the existential in (32), given the surface position of *ka* and the relevant coordinators.

(32) a. [Dare-**ka**-ga kita-kara] Taro-wa yorokondeita.
who-KA-NOM came-because Taro-TOP was.happy
'Because someone came, Taro was happy.' ('because' $>$ $\exists$)

b. [Dare-**ka**-ni au-tame] Taro-wa hayaku daigaku-ni kita.
who-KA-DAT meet-in.order.to Taro-TOP early university-GOAL came.
'Taro came early to the university to meet someone. ('in order to' $>$ $\exists$)

Since a form is blocked only if the simpler competitor has the same interpretation, the blocking does not apply to (28), and hence they are grammatical.

On the other hand, the following examples where *ka* appears right below the relevant coordinators are ungrammatical.

(33) a. *[Dare-ga kita-**ka**-kara] Taro-wa yorokondeita.
who-NOM came-KA-because Taro-TOP was.happy
'Because someone came, Taro was happy.'

b. *[Dare-ni au-**ka**-tame] Taro-wa hayaku daigaku-ni kita.
who-DAT meet-KA-in.order.to Taro-TOP early university-GOAL came.
'To meet someone, Taro came.'

This is as expected since they have the same interpretations as the sentences in (32). The sentences in (32) block those in (33), making the latter ungrammatical.

4.3. *ka*-disjunction under proposition-taking predicates

The blocking account for the ungrammaticality of *ka*-ending CPs under proposition-embedding predicates discussed above also applies to *ka*-disjunctions. For example, the ungrammaticality of (34) is explained by blocking from the simpler competitor involving a DP-*ka*-disjunction in (35).

(34) *Taro-wa [Hanako-ga hashitta-ka ∅ Jiro-ga hashitta-ka ⟨?⟩] shinjiteiru.
Taro-TOP Hanako-NOM ran-KA Jiro-NOM ran-KA C_{int} believe
Intended: 'Taro believes that either Hanako ran or Jiro ran.'

(35) Taro-wa [[Hanako-ka ∅ Jiro-ka]-ga hashitta-to] shinjiteiru.
Taro-TOP Hanako-KA or Jiro-KA -NOM ran-C_{decl} believe
'Taro believes that either Hanako ran or Jiro ran.'

Furthermore, importantly, exactly the same prediction as in the *wh*-case holds in the disjunction case. That is, the blocking does not occur when there is no semantically equivalent alternative. Again, we can see this in examples involving CP adjuncts:

(36) Taro-wa [Hanako-ga kita-kara-**ka** ∅ Jiro-ga kita-kara-**ka**]
Taro-TOP Hanako-NOM came-because-KA Jiro-NOM came-because-KA
yorokondeita.
was.happy
'Taro was happy either because Hanako came or because Jiro came.' (∨ > 'because')

Just as in the *wh* case, the crucial reason why (36) is not blocked is that it lacks a more economical alternative *with the equivalent interpretation*. An alternative with the DP-sized *ka*-disjunction below would lead to a distinct interpretation where the disjunction scopes below 'because'.

(37) Taro-wa [[Hanako-**ka** ∅ Jiro-**ka**]-ga kita-kara] yorokondeita.
Taro-TOP Hanako-KA or Jiro-KA -NOM came-because believe
'Taro was happy because either Hanako or Jiro came.' ('because' > ∨)

Thus, the parallelism between *wh+ka* and *ka*-disjunctions manifests itself here as well.

4.4. Summary

To summarize Section 4, the existential closure at the clausal level is in principle possible, but some *ka*-ending clauses where existential closure could be applied are made ungrammatical for an independent reason, i.e., blocking from the more optimal *wh-ka* local sequence. This account predicts that existential closure at the clausal level is possible if there is no competitor with the same interpretation. It was shown that this prediction is borne out in the domain of CP adjuncts. Existential closure above CP-adjuncts is possible since the sentences with lexical competitors would have different interpretations.

The possibility of analyzing sentences like (28) and (36) is another advantage of the current analysis over previous approaches. Previous approaches such as Hagstrom (1998) and Shimoyama (2006) make a binary distinction between the DP-internal existential *ka* and the question particle *ka* in the complementizer position. The empirical coverage of such accounts does not encompass the existential interpretation of *ka*-ending clauses discussed in this section, as well as the detailed patterns about when it is disallowed.

5. Conclusions

In this paper, I proposed a unified analysis of indefinites, *wh*-questions and disjunctions involving the particle *ka* in Japanese. According to the analysis, *ka* is analyzed as an operator that always projects a set of alternatives in the ordinary-semantic dimension. The crucial claim is that this set has to be turned into an existential quantifier by the operation of existential closure if and only if it cannot by itself enter the semantic composition with the rest of the sentence without a type-mismatch. This accounts for the fact that *wh+ka* is interpreted as an indefinite when it forms a sub-CP phrase while it is interpreted as a *wh*-question when it forms a matrix CP, or a CP embedded by a question-embedding predicate.

Furthermore, employing the Junction-based syntactic analysis of disjunctions (den Dikken, 2006; Mitrovič and Sauerland, 2014; Szabolcsi, 2015), this analysis can be extended to disjunctions of the form α-*ka* β-*ka*. According to this analysis, α-*ka* β-*ka* denotes the set $\{[\![\alpha]\!], [\![\beta]\!]\}$ in the ordinary-semantic dimension. This analysis offers a natural account of the fact that the interpretation of α-*ka* β-*ka* depends on the syntactic size of the *ka*-phrases, in a way parallel to how the interpretation of *wh+ka* depends on its syntactic size. When α-*ka* β-*ka* is of a sub-CP size, it is type-shifted into the disjunctive meaning. When α-*ka* β-*ka* is of a CP size, it is interpreted as an alternative question.

Note that this proposal is a conservative extension of existing proposals which have been argued for from independent grounds. The unified analysis of indefinites and questions in terms of the notion of alternatives has been extensively defended at least since Kratzer and Shimoyama (2002), and the extension of this program to the JP structure is undertaken by Mitrovič and Sauerland (2014) and Szabolcsi (2015). The role of Q-particle as an operator that brings the alt-value of the prejacent to the o-value is proposed by Beck (2006) and Kotek (2014), and is shown to have further positive consequences for independent empirical problems such as the intervention effect and the interpretation of multiple *wh*-questions. Two things set the current proposal distinct from existing proposals: (i) the adoption of the above semantics for the Q-particle for its *clause-internal* use, not only for its *clause-final* use; and (ii) the employment of type-compatibility and existential closure in the account of the interpretations of *ka*-ending phrases. Throughout the body of the paper, I have argued that addition of these two claims have far-reaching consequences, including a unified analysis of indefinites and *wh*-questions, an account of the parallelism between *wh+ka* and *ka*-disjunctions, and an analysis of the existential interpretations of some *ka*-ending clauses.

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On the similarity between *unless* and *only-if-not*[1]

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Abstract. This paper discusses the semantics of *unless*-conditionals and compares them to *only-if-not*-conditionals. I propose that the meaning of *unless*-conditionals can be derived from the same ingredients as the meaning of *only-if-not*-conditionals: a negative conditional (where conditionals are understood as restrictors on quantifier domains as in the Kratzer-Lewis tradition) and an exhaustifier that, like *only*, negates all of the focus alternatives for a modal claim built by substitution of the element marked with focus with other elements of the same semantic type (but unlike *only* also asserts its prejacent). I propose that the two constructions are similar in the following sense. First, in both cases a negative conditional and the exhaustifier are separated syntactically. Secondly, focus alternatives are constructed in the same way: a set of focus alternatives for a proposition denoted by an *if*-clause (or a complement of *unless*) includes any other possible proposition. I suggest that this way of constructing alternatives resolves a long-standing puzzle about *only* with conditionals: it allows us to derive the right interpretation for *only* with conditionals in a compositional manner without making any special assumptions about the nature of the covert modal.

Keywords: *only*, conditionals, Conditional Excluded Middle, *unless*, exceptives

1. Introduction

In this paper I will discuss the semantics of *unless*-conditionals and compare them to *only-if-not*-conditionals (1).

(1) a. Unless it rains, the party will be outside.
    b. Only if it does not rain, will the party be outside.

The analysis I propose is built on the idea that *unless* means (almost) the same thing as *only if not* (Clark and Clark, 1977: 457; Quirk, Greenbaum, Leech, and Svartvik, 1972: 746) or rather *if and only if not* (Comrie, 1986: 79). I will argue that there is an advantage in analyzing these two constructions in a similar way syntactically. I will suggest that the meaning of *unless*-conditionals can be derived from two ingredients: a negative conditional statement and an unpronounced exhaustifier that has a meaning similar to *only*.

The approach I suggest is a modified version of von Fintel's (1994) approach to *unless*-conditionals, according to which they are exceptive constructions in a modal domain: *unless* subtracts a set denoted by its complement from a domain of a modal operator (*unless* acts like *if not* in a Kratzer-Lewis system (Lewis, 1975; Kratzer, 1978, 1986), where conditionals restrict domains of modal operators) and states that subtraction of any alternative proposition makes the quantificational claim false.

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Building on the recent proposals made for *but*-exceptives (Gajewski, 2008, 2013; Hirsch, 2016), I suggest that domain subtraction and exhaustification should be separated syntactically. I will argue that this separation provides an explanation for weak NPI-licensing in *unless*-clauses. I suggest that *unless* marks its complement with focus and is obligatorily c-commanded by "O", which is identical to *only* except that it asserts its prejacent. "O" applies to an entire clause with a modal operator and negates all the alternatives for this clause that are built by substitution of the element marked with focus (the complement of *unless*) by its alternatives. The crucial aspect of the proposed analysis is that the set of alternatives for the complement of *unless* includes all possible propositions. I will show how this approach explains the known differences between *unless* and *if not*.

There is a long-standing puzzle about deriving the meaning of exhaustifiers like *only* with conditionals in a compositional manner (Barker, 1993; von Fintel, 1997; Herburger, 2015). Since "O", like *only*, involves negation of focus alternatives, the same puzzle arises for the proposed theory of *unless*-conditionals. There are two solutions to this puzzle proposed in the literature and both of them involve a special stipulation about the nature of the covert modal. According to the first one, bare conditionals obey the principle of Conditional Excluded Middle (Barker 1993; von Fintel 1997), and according to the second one, the covert modal obligatorily changes its modal force and becomes an existential quantifier under negative operators like *only* (Herburger, 2015).

I will show that it is possible to resolve the puzzle of *only* with conditionals without appealing to any special stipulation by extending my analysis of *unless*-conditionals to regular conditionals with *only*. I will argue that the right interpretation for those sentences follows naturally if we allow the set of possible alternatives for a proposition denoted by an *if*-clause to include not only the proposition itself and its negation (as it standardly assumed), but any possible proposition.

The discussion will go as follows. In Section 2 I will introduce the properties of *unless*-conditionals and von Fintel's analysis of them. I will propose my analysis for *unless*-conditionals. I will suggest separating domain subtraction and exhaustification syntactically. In Section 3 I will discuss the puzzle posed by combining *only* with conditionals and the Conditional Excluded Middle (CEM) as a solution to this problem. I will show that the analysis of *unless*-conditionals suggested here (as well as von Fintel's analysis of *unless*-conditionals) is not compatible with CEM. In Section 4 I will propose a novel solution to the problem of *only* with conditionals: I will extend the core idea of von Fintel's approach to *unless*-conditionals to *only-if*-conditionals and allow the set of alternatives for a proposition denoted by an *if*-clause to include any other possible proposition. In Section 5, I will discuss the consequences and predictions of the suggested approach. Section 6 concludes.

2. The semantics of *unless*-conditionals

2.1. *Unless* is not equivalent to *if not*.

Unless-conditionals express a negative condition and their meaning is close to *if not*. The similarity between *unless* and *if not* can be demonstrated by the following pair of sentences (2)a and (2)b.

(2) a. Unless it rains, the party will be outside.
b. If it does not rain, the party will be outside.

However, Geis (1973) in his classic paper provided several arguments against the idea that *unless* is equivalent to *if not*. The first argument given by Geis is that two *unless*-clauses cannot be coordinated (3). Two *if*-clauses – positive or negative – can be coordinated, as shown in (4).

(3) *Unless it rains and unless I am sick, the party will be at my house.

(4) If it does not rain and if I am not sick, the party will be at my house.

Geis also shows that *unless* does not combine with operators like *only*, *even*, and *except* ((5) and (6)), unlike negative *if*-clauses ((7) and (8)).

(5) *The party will be outside only unless it rains.

(6) *The party will be outside even/except unless the weather is good.

(7) The party will be outside only if it does not rain.

(8) The party will be outside even/except if the weather is not good.

Another difference between *if-not*- and *unless*-clauses noticed by Geis is their ability to host NPIs. Geis argued that NPIs are not licensed in *unless*-clauses at all. However, von Fintel (1994) showed that this is true only for strict NPIs like *yet* (9); weak NPIs like *anyone* can be licensed in *unless*-clauses (11).

(9) *Ivan will be upset **unless** Bill has come **yet**.

(10) Ivan will be upset **if** Bill has **not** come **yet**.

(11) **Unless anyone** objects, we must move on.

Another contrast between *if not* and *unless* is that *then* is not allowed in consequents of *unless*-conditionals (12) (Fretheim, 1977; von Fintel, 1994).

(12) Unless it rains, (*then) the party will be outside.

(13) If it does **not** rain, then the party will be outside.

Following Geis, we can conclude that *unless* is not equivalent to *if not*, and any semantic theory of *unless* should explain the differences between *unless* and *if not* that we observe here.

2.2. *Unless* as an exceptive construction

Von Fintel (1994) proposed that *unless* makes the following contribution to the meaning of a sentence (14).

(14) $[[\ [_S [_S \text{ unless } \alpha] [_S \ Q_{C1} \ \beta]]\ ]]^g = T$ iff $g(C_1)(w)–[[\alpha]]^g \subseteq [[\beta]]^g\ )$ &
$\forall Y(\ (g(C_1)(w)–Y \subseteq [[\beta]]^g) \rightarrow [[\alpha]]^g \subseteq Y)\}$
where $[[\alpha]]^g = \{w: [[\alpha]]^{g,w} = T\}$

In (14) Q_C stands for a universal modal operator.[2] Its index C is a covert domain restriction variable: it denotes a function that applies to a world and returns a set of worlds accessible from that world. α is a complement of *unless*; it is interpreted a set of possible worlds that is subtracted from the domain of the modal operator. β is the constituent that denotes a set of worlds that the modal takes as its second argument.

The first conjunct in (14) is a modal claim, where the denotation of α is subtracted from the domain of the modal quantifier. The second conjunct is the exhaustification or the leastness condition. It universally quantifies over possible propositions (sets of possible worlds) that can be subtracted from the domain of the modal operator instead of the proposition denoted by the original complement of *unless*. It states that if the resulting modal claim is true, then the original subtracted set is a subset of this set of possible worlds.

In other words, it negates all the resulting modal claims with exception of those that are already entailed by the original modal claim. The modal operator is assumed to be a universal quantifier. The structural position of the original restrictor R is in an upward entailing context (as it is under negation and in the restrictor of a universal quantifier). If R is substituted by its superset, the resulting modal claim will be entailed by the original modal claim, therefore its negation will contradict the original claim. This semantics predicts that two *unless*-clauses cannot be coordinated. The clause in (14) says that the set denoted by α is the unique minimal set subtraction of which from the domain of the modal operator makes the quantificational claim true. There cannot be two such unique sets.

2.3. Separating domain subtraction from exhaustification syntactically

One of the properties of *unless*-clauses is their ability to host weak NPIs (15).

(15) **Unless anyone** objects, we will move on.

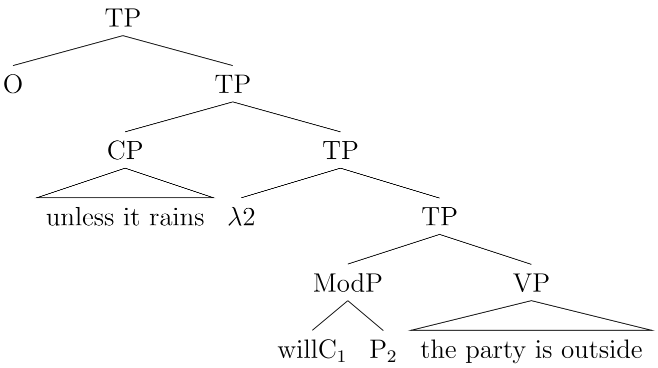
This fact is not predicted by von Fintel's approach, where the domain subtraction and exhaustification are done in one step. The reason for this is the first conjunct of the formula in (14) that simply expresses the domain subtraction. The structural position of the constituent α

[2] *Unless*, due to its semantics, cannot apply to existential modals (von Fintel, 1994). The assumption is that in cases where an existential modal is overtly present in a sentence, *unless* operates on an unpronounced universal modal and an existential takes scope below it.

is not in a downward entailing context, because it is in the restrictor of the universal quantifier and under negation.

To account for the fact that weak NPIs are licensed in *unless*-clauses I propose that domain subtraction and exhaustification should be separated syntactically, as shown in (17). I will make the simplifying assumption that syntactically a modal forms a constituent with a variable of type <s,t>. The value of this variable is provided by the *unless*-clause via the mechanism of lambda abstraction.

(16) Unless it rains, the party will be outside.

(17)


Unless subtracts its complement (a proposition) from a domain of a modal operator (18) (thus an *unless*-clause is equivalent to a negative *if*-clause in the Kratzer-Lewis tradition (Lewis, 1975; Kratzer, 1978, 1986), where conditionals restrict domains of various operators).

(18) $[[\text{unless}\ \alpha]]^{w,g} = \{w_1 : w_1 \notin [[\alpha]]^g\}$

(19) For any sets of worlds P and Q, $[[\text{will}_{C1}]]^{w,g}(P)(Q) = T$ iff $g(C_1)(w) \cap P \subseteq Q$
(where C_1 is a variable standing for an accessibility function from worlds to sets of worlds).

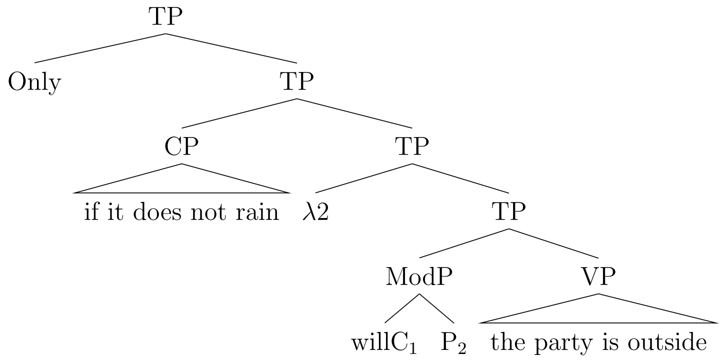
Unless marks its complement with focus and must be c-commanded at LF by “O”.[3] The set of focus alternatives for a proposition p includes any other possible proposition. (The advantages of constructing alternatives in such a way will be shown in Section 4.) “O” c-commands the entire sentence containing an *unless*-clause. “O” has exactly the same semantics as *only* except that it asserts its prejacent (Chierchia, 2013) (20). It states that for each set of worlds such that it is a member of the set of focus alternatives of the original sentence and the world of evaluation is one of them, the set of worlds denoted by the original sentence is a subset of it. It essentially negates each of the focus alternatives except for the ones that are entailed by the original sentence. It also states that the evaluation world is a member of the set denoted by the original sentence; that is, it asserts its prejacent.

(20) **“O”:** $[[O\ \alpha]]^{w,g} = T$ iff $\forall r\ [(r \in [[\alpha]]^g{}_f\ \&\ w \in r) \rightarrow [[\alpha]]^{w,g} \subseteq r]\ \&\ [[\alpha]]^{w,g}$

[3] The reasons why “O” is chosen as an exhaustifier and not the leastness operator are given in the Appendix.

Under the assumption that *only* also c-commands the entire sentence, *unless*-conditionals are structurally parallel to *only-if-not*-conditionals.

(21)



Because “O”, unlike *only*, asserts its prejacent, *only-if-not*-conditionals are not predicted to be completely semantically equivalent to *unless*-conditionals. However one part of their meaning is predicted to be the same, namely the one that comes from negation of all alternatives that are formed by substitution of a conditional clause by its alternatives.

3. The problem of *only if*

In this section I will introduce the puzzle posed by applying of exhaustifiers like *only* (or “O”) to conditionals.

3.1. The problem of *only* with bare conditionals

Deriving the meaning of *only* with conditionals in the absence of an overt modal operator (so-called bare conditionals) in a compositional manner is not an easy task. To see why, let us consider what *only* and *if* mean independently.

According to the standard assumptions about the semantics of *only*, it applies to a proposition (its prejacent) and negates all of the contextually relevant alternative propositions derived by substitution of the element marked with focus in the original sentence with elements of the same semantic type (Rooth, 1985). Thus the claim in (22) is true if and only if each of the claims in (23) is true.

(22) Only John came to the party.

(23) Bill did not come, Mary did not come, Jack did not come, etc.

Our goal is to derive the meaning of an *only if* claim, like the one in (24), by using the same ingredients: *only* and focus alternatives for its prejacent.

(24) Only if the queen is home, is the flag up.

The meaning of (24) can be roughly paraphrased as (25).

(25) In **all** worlds in which the queen is **not** home, the flag is **not** up.

Thus the result of applying *only* to a bare conditional seems to be a modal claim where the modal has the universal force, the restrictor is the negation of the original *if*-clause in (24) and the scope is the negation of the original scope.

There are two major problems with (24) that are extensively discussed in the literature. The first one is that (24) does not seem to presuppose that if the queen is home, the flag is up, even though normally *only* presupposes its prejacent (McCawley, 1974). The second problem is that it is not clear how to derive (24) from (25) given our standard assumptions about the semantics of conditionals and *only* (Barker, 1993; von Fintel, 1997; Herburger, 2015). I will set the first issue aside in this paper and focus on the second problem.

The prejacent of *only* in (26) taken by itself seems to be a universal modal assertion.

(26) If the queen is home, the flag is up.

The meaning of (26) (the prejacent) is something like (27), which I will represent as (28).[4]

(27) In **all** worlds where the queen is home, the flag is up.

(28) $[[(27)]]^{g,w}$ is T iff $P \subseteq Q$
where P = {w: the queen is home in w} and Q = {w_1: the flag is up in w_1}

Only negates all of the alternatives for its prejacent that are created by substitution of the focused element with other expressions of the same type. The focused element in this case is the *if*-clause (the meaning of which I represented with P). Since our goal is to get a modal claim with a restrictor that is the negation of the original restrictor, the alternative we are particularly interested in is the one given in (29). Under the assumption that the set of focus alternatives for a proposition only includes the proposition itself and its negation, this is the only alternative that can be negated without contradicting the original claim.

(29) $P' \subseteq Q$
(where P' stands for a complement of P, the original set)

Negation of this universal claim will result in an existential claim that can be paraphrased as (30). This is not the desired result, because (30) is too weak.

(30) In **some** worlds where the queen is **not** home, the flag is **not** up.

In what follows, I will review one of the existing solutions to this puzzle, according to which the covert modal operator obeys the principle of conditional excluded middle (CEM). I will show that the semantics for *unless*-conditionals developed here, as well as the semantics of *unless*-conditionals suggested by von Fintel, is not compatible with this principle. I will

[4] This semantics for conditionals completely ignores an accessibility relation. I omit the accessibility relation only for simplicity of exposition. (I make a simplifying assumption here that all worlds are accessible from all worlds.) In the Appendix, I show that my result holds in case we add an accessibility relation.

propose a novel solution to this puzzle that does not appeal to this principle and does not postulate any other special property of bare conditionals, but rather changes the way we construct the set of focus alternatives for a conditional clause.

3.2. Conditional excluded middle as a possible solution for the *only-if* puzzle

One of the existing solutions to this puzzle adopts the idea that bare conditionals obey the principle of conditional excluded middle (CEM) (Barker, 1993; von Fintel, 1994, 1997). In a theory-neutral way the principle of CEM can be expressed as follows: two claims "if p, q" and "if p, not q" cannot both be false.[5] The exact realization of this principle depends on the approach to the semantics of conditionals that one adopts. Von Fintel (1994) develops the idea that the covert universal modal operator that bare conditionals restrict – the generic operator – carries a homogeneity presupposition. A very simplified[6] semantics for GEN is given in (31).

(31) For any sets of worlds A and B, $[[\text{GEN}]]^{g,w}(A)(B)$ is defined only if $A \subseteq B \vee A \subseteq B'$.
If defined $[[\text{GEN}]]^{g,w}(A)(B)$ is T iff $A \subseteq B$.

Because of the homogeneity presupposition GEN is predicted to obey CEM (32). Essentially the higher scope negation over GEN is interpreted as the lower scope negation operating only on the proposition in scope of GEN.

(32) CEM for GEN: $\neg\, [[\text{GEN}]]^{g,w}(A)(B) \Leftrightarrow [[\text{GEN}]]^{g,w}(A)(\neg B)$

This solves the puzzle of *only* with bare conditionals in the following way. *Only* negates the only alternative given in (33). The homogeneity presupposition says that both (33) and (34) cannot be false, thus negation of (33) entails that (34) must be true.

(33) $P' \subseteq Q$

(34) $P' \subseteq Q'$

This is exactly the desired result, since (34) can be paraphrased as (35).

(35) In **all** worlds where the queen is **not** home, the flag is **not** up.

3.3. CEM as a problem for the analysis of *unless*-conditionals

The semantics for *unless*-conditionals developed in Section 2.3, as well as the semantics suggested by von Fintel (1994) introduced in Section 2.2, is not compatible with CEM. It essentially involves negation of all the alternatives built by substitution of the complement of *unless* with a different proposition. If we consider the claim in (36), then the set of negated

[5] For arguments against CEM see Leslie (1997).
[6] This semantics is simplified because it completely ignores the accessibility relation or the selection function that von Fintel uses to restrict the domain of GEN and account for the fact that GEN only makes a claim about relevant normal situations.

alternative modal claims will include things like the ones given in (37), because the list of the alternatives for a complement of *unless* includes any other possible proposition (that is not a superset of the original proposition).

(36) Unless it rains, the party will be outside.

(37) $\{\neg\ [g(C_1)(w_0) - \{w_1\text{: I call my mom in } w_1\} \subseteq \{w_1\text{: the party is outside in } w_1\}],$
$\neg\ [g(C_1)(w_0) - \{w_1\text{: John is late in } w_1\} \subseteq \{w_1\text{: the party is outside in } w_1\}],$
$\neg\ [g(C_1)(w_0) - \{w_1\text{: it snows in } w_1\} \subseteq \{w_1\text{: the party is outside in } w_1\}], \text{etc.}\}$
(where C_1 stands for a contextually determined accessibility function)

If the high scope negation is interpreted as the low scope negation (because of CEM) we will end up with truth-conditions that involve a set of universal claims like the ones in (38). The claims listed in (38) are clearly not a part of what (36) means.

(38) In **all** worlds in which I don't call my mom, the party is **not** outside,
In **all** worlds in which John is not late, the party is **not** outside,
In **all** worlds in which it does not snow, the party is **not** outside, etc.

Moreover, the set of possible alternatives for the complement of *unless* includes all possible propositions, thus it will include not only the proposition denoted by *it snows*, but also the proposition denoted by its negation *it does not snow*. Putting those two propositions instead of the original complement of *unless* and negating the resulting modal claims by CEM is equivalent to saying that the party is not outside in all possible worlds (39). This contradicts the original modal claim that states that the party is outside in all worlds where it does not rain.

(39) In **all** worlds in which it does **not** snow, the party is **not** outside.
In **all** worlds in which it **snows**, the party is **not** outside.

This line of argumentation shows that the semantics for *unless*-conditionals suggested in this paper is not compatible with the principle of Conditional Excluded Middle that has been argued to be necessary to solve the problem of *only-if*-conditionals. In the next section I will show that CEM is not needed to solve the *only if* puzzle.

4. How to construct the alternatives for conditionals: *only if* without CEM

In this section I will show that we can derive the meaning of conditionals with exhaustifiers like *only* in a compositional manner if we drop the assumption that the set of focus alternatives for a proposition (denoted by an *if*-clause) includes only the proposition itself and its negation. I will show that if we allow this set to include any other possible proposition, the problem of *only if* can be solved without CEM or any special stipulations about the nature of the covert modal.

Let us go back to our example (24) (repeated as (40)). Its prejacent expresses the modal claim in (41).

(40) **Only if** the queen is home, is the flag up.

(41) $P \subseteq Q$
Where $P = \{w\text{: the queen is home in } w\}$,
$Q = \{w_1\text{: the flag is up in } w_1\}$.

Only will negate all of the alternatives for this sentence that are created by substitution of the focused element with other expressions of the same type except for those that are entailed by the original sentence. The focused element in this case is the *if*-clause that I represented by R. Normally, *only* is represented as a quantifier over propositions or sets of worlds, as in (42). The contribution of *only* is to say that, for every proposition in the set of focus alternatives, if that alternative is true then it is entailed by the original sentence.[7]

(42) $[[\text{Only } \alpha]]^{w,g} = T \text{ iff } \forall r\, [(r \in [[\alpha]]^{g}{}_{f}\ \&\ w \in r) \rightarrow [[\alpha]]^{g} \subseteq r]$

In our case, whether a particular alternative is entailed by the original claim depends solely on the properties of its restrictor, because the alternatives differ from the original claim only with respect to their restrictor.

The universal quantifier is downward entailing on its first argument. Therefore the alternatives that are created by substitution of R by a subset of R are entailed by the original claim and cannot be negated by *only*. All other alternatives are negated.

Given this, we can represent the contribution of *only* by quantifying over alternative restrictors. We need to say that for every alternative restrictor, if it makes the quantification claim true, then this restrictor is a subset of the original restrictor. The formula in (43) says exactly the same thing as *only* applied to this particular modal construction.

It specifies the exact form of the alternatives (the antecedent of the material implication in (43)). It also specifies what it means for a resulting alternative quantificational claim to be entailed by the original one (the consequent of the material conditional in (43)): its restrictor is a subset of the original restrictor. This is because all and only quantificational claims with restrictors that are subsets of the original restrictor are entailed by the original quantificational claim.

(43) $\forall Y\, (Y \subseteq Q \rightarrow Y \subseteq P)$

Based on this way of representing the contribution of *only*, it can be shown that negation of all of the alternatives for (41) (with the exception of those that are entailed by the original sentence) entails that in all worlds in which the flag is not up, the queen is not home. The relevant proof is given in (44).

[7] In set talk: for any set of worlds if it is a member of the set of focus alternatives and the actual world is a member of this set, then the set of worlds denoted by the original sentence is its subset.

(44) a. $\forall Y\ (Y \subseteq Q \rightarrow Y \subseteq P) \Rightarrow$
b. $Q \subseteq P \Leftrightarrow$
c. $P' \subseteq Q'$
(where P' stands for the complement set of P and Q' stands for the complement set of Q, following the standard notation.)

The claim in (44)c can be paraphrased as (45).

(45) In **all** worlds where the queen is **not** home, the flag is **not** up.

The proof in (44) shows that if we take focus alternatives for a proposition denoted by an *if*-clause to be any possible proposition and negate all alternatives for an entire conditional (excluding the ones that are entailed by the original claim), we get the desired interpretation for *only* with bare conditionals.

5. The results of the suggested approach

In this section I will discuss the meaning of *unless*-conditionals and *only-if-not*-conditionals that is predicted by the approach suggested in this paper. I will also show that this approach explains the properties of *unless*-conditionals discussed in Section 2.

5.1. The predicted meaning of *unless*-conditionals and *only-if-not*-conditionals

The predicted meaning of (46) is given in (47). The first conjunct in (47) comes as a result of negating of all the alternatives for a modal claim. As was shown above, negation of all the alternatives in this case gives us the universal claim with the restrictor being the negation of the original restrictor and the scope being the negation of the original scope.[8] The second conjunct is the prejacent of "O" (and the *unless*-clause is interpreted as a negative *if*-clause).

(46) Unless it rains, the party will be outside.

(47) $[[(46)]]^{g,w0} = T$ iff $g(C_1)(w_0) \cap \{w\text{: it rains in } w\} \subseteq \{w\text{: the party is outside in } w\}'$
$\& \ g(C_1)(w_0) \cap \{w\text{: it rains in } w\}' \subseteq \{w\text{: the party is outside in } w\}$

The predicted meaning of (48) is given in (49). This is the result of exhausting the alternatives. The semantics for *only if not* does not contain the second conjunct because *only* does not assert its prejacent.

(48) Only if it does not rain, will the party be outside.

(49) $[[(48)]]^{g,w0} = T$ iff $g(C_1)(w_0) \cap \{w\text{: it rains in } w\} \subseteq \{w\text{: the party is outside in } w\}'$

[8] Here I introduce the accessibility relation. The proof that was given in Section 4 ignored it. I demonstrate that adding the accessibility relation will give the same result in (47) in the Appendix.

The universal claim in (49) is the shared part of the meaning of the *unless*-conditional in (46) and *only-if-not*-conditional in (48). By making *only if not* and *unless* structurally and semantically similar this approach correctly predicts that (46) and (48) are very close in meaning. *Unless*-conditionals are predicted to be closer to *if-and-only-if*-conditionals, due to the fact that "O" asserts its prejacent and *only* does not.

5.2. Explaining the properties of *unless*-conditionals

5.2.1. Weak NPI licensing in *unless*-clauses

Weak NPIs are licensed in *unless*-clauses, as we saw before in (11) (repeated here as (50)).

(50) Unless **anyone** objects, we must move on.

Under the standard account NPIs like *any* and *ever* require downward entailing (DE) environments (Fauconnier, 1975, 1978; Ladusaw, 1979). To explain the ability of *unless*-clauses to host weak NPIs, I will adopt the environment-based approach to NPI licensing (Chierchia, 2004; Gajewski, 2005; Homer, 2011), according to which an NPI is licensed if there is a constituent containing that NPI which is the proper environment for that NPI.

For example, in (51) *any* is licensed, even though if we consider the entire sentence the position of *any* is not in DE context. Two DE operators – the lower clause negation and *no one* – make the environment of *any* upward entailing. However, there is a constituent in the sentence such that it is a proper environment for the NPI – the embedded negative sentence (this constituent is underlined in (51)).

(51) **No** one thinks that <u>John has **not** done any work</u>.

According to the account proposed in this paper the exhaustifier "O" and domain subtraction are separated syntactically. The constituent where *any* is licensed in (64) is the *unless*-clause itself, interpreted as *if not*. Thus the NPI licenser in this case is the negation or domain subtraction.

5.2.2. No licensing of strict NPIs: bi-clausal structure of *unless*-clauses

Strict NPIs, like *in years*, are not licensed in *unless*-clauses, see (52).

(52) * **Unless** John has visited Mary **in years**, I am happy. (Geis, 1974)

However, negation is known to license strict NPIs. To account for the strict NPI facts in *unless*-clauses, I suggest that *unless*-clauses have a more complex structure than they appear to have. I propose that *unless*-clauses consist of two clauses: they have a structure similar to "if it is **not** the case **that p**".

In years is not licensed if it is separated from negation by a finite clause boundary, as shown in (53). As (54) shows, this is not a problem for *any*. I propose that *in years* is not licensed in (52) for the same reason it is not licensed in (53): in both cases *in years* appears in a positive clause. Negation is too high to license the strict NPI. The schematic representation of the syntactic structure of an entire *unless*-conditional like (55) is given in (56). The *unless*-clause is marked in bold. This is the constituent in which weak NPIs are licensed.

(53) *It is **not** true **that** John has visited Mary **in years**.

(54) It is **not** true **that** John talked to **anyone**.

(55) Unless anyone objects, we will go on.

(56) [$_{TP}$ O [$_{CP}$ **[$_{CP}$ un [$_{PolP}$ less [$_{vP}$ ∅ [$_{CP}$ [∅$_{Com}$ anyone objects]]]]** [$_{TP}$ we will$_{C1}$ go on]]

The evidence in favor of this syntactic structure comes from the historical development of *unless*-conditionals. The *unless*-construction originates from *on lesse that, lesse than*, or *in*/*on*/*of lesse than* (one relevant example from Traugott (1997) is given in (57)).

(57) That thar sholde no Statut no Lawe be made, **oflasse than** they yeaf thereto their assent.
That no statute nor law should be made **unless** they gave their consent to it.
(1414 Parlt [HC] as cited by Traugott (1997) (her example (14c))

Thus at some point the domain subtraction was overtly separated from its complement by a finite clause boundary. I suggest that even though this clause boundary is not expressed overtly any longer in present-day English, native speakers are still sensitive to its presence.

5.2.3. *Unless* with *even* and *only*

I proposed that *unless* marks its complement with focus and is obligatorily c-commanded by a focus sensitive operator "O". This provides a natural explanation for the fact that *unless*-clauses cannot be associated with focus sensitive operators like *even* and *only*.

Elements that are already associated with one focus sensitive operator cannot be associated with another one (60). Thus the restriction observed in (58) is the same as the one observed in (59) and (60).

(58) *The party will be outside only unless it rains.

(59) *The party will be outside only only if it does not rain.

(60) *Bill gave flowers even only to Sue.

5.2.4. Coordination facts

The fact that two *unless*-clauses cannot be coordinated follows from the semantics proposed in this paper. Given this analysis, there predicted to be a conflict between the meaning of the first conjunct ("unless John leaves today I will leave") and the meaning of the second conjunct ("unless Joe leaves today I will leave") in (61).

(61) *Unless John leaves today and unless Joe leaves today, I will leave.

"O" negates all of the focus alternatives for the modal claim in the first conjunct. One of the alternatives for the complement of *unless* in the first conjunct is the proposition denoted by *Joe leaves today*. Thus the list the alternatives that "O" negates will include the modal claim in (62). "O" asserts its prejacent. The contribution of the prejacent of "O" in the second conjunct is given in (63). Negation of (62) directly contradicts (63). Conjunction of two *unless*-clauses will always result in a contradiction of this sort.

(62) $\neg$ [g(C$_1$)(w$_0$) $\cap$ {w: Joe leaves today in w}' $\subseteq$ {w: I leave in w}]

(63) [g(C$_1$)(w$_0$) $\cap$ {w: Joe leaves today w}' $\subseteq$ {w: I leave in w}]

5.2.5. *Then* in *unless*-clauses

Then is ungrammatical in both (64) and (65).

(64) ***Unless** it rains, then the party will be outside.

(65) ***Only** if it does not rain, then the party will be outside.

I will adopt the proposal by Iatridou (1994) and von Fintel (1994), according to which conditionals with *then* are examples of the left-dislocation construction. There are restrictions on what kind of items can be left-dislocated and those restrictions explain ungrammaticality of *then* in such conditionals.

An example of the left-dislocation construction is given in (66). In (66) a DP *the girls you invited* is left-dislocated. It is followed by a full clause, the subject position of which is occupied by the resumptive pronoun *they*. This pronoun picks up the same group of individuals as the left-dislocated DP (*the girls you invited*).

(66) The girls you invited, they are interesting.

Iatridou (1994) and von Fintel (1994) point out that focus sensitive operators like *only* and *even* cannot be associated with left-dislocated items ((67), (68)).

(67) ***Only** the girls you invited, they're interesting.

(68) ??**Even** the girls you invited, they're interesting.

Treating conditionals with *then* as examples of the left-dislocation construction allows us to reduce the restriction observed in (64)-(65) to the restriction observed in (67)-(68).

6. Conclusion

In this paper I offered an analysis of *unless*-conditionals, which is built on the observation going back to the work of Comrie (1986) that *unless*-conditionals mean the same thing as *if* *and only if not*. I suggested an approach that takes this idea literally and derives the meaning of *unless*-conditionals from a negative conditional, focus alternatives and an operator “O” that is exactly like *only* except that it asserts its prejacent.

I argued that there is a parallelism between *only-if-not-* and *unless*-conditionals. First of all, in both cases a negative condition (interpreted as a restrictor on a universal modal) and exhaustification are contributed by two items separated syntactically. This provides an explanation for weak NPI licensing in *unless*-clauses. Secondly, the list of alternatives for *unless*-conditionals and for *only-if-not*-conditionals that are negated by an exhaustifier is constructed in the same way. I suggested that a set of alternatives for a proposition denoted by an *if*-clause or by a complement of *unless* has to include all possible propositions. I showed that this way of constructing alternatives provides a natural solution to the problem of *only* with bare conditionals. In this way, this proposal derives the right interpretation for conditionals with *only* in a compositional manner without any stipulations about the nature of the covert operator that conditionals restrict.

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Appendix. The leastness condition vs "O".

In this appendix I would like to demonstrate two things. The first is that the result of using "O" is predicted to be slightly different than the result of using the leastness condition proposed by von Fintel (1994) (reviewed in Section 2.2). The second one is that if a modal has a complex restrictor that includes an accessibility relation, the result of negating alternatives for this modal claim formed by substitution of a proposition denoted by an *if* or *unless*-clause with any other possible proposition will give us the right interpretation for the sentence. I will demonstrate this using the example in (1).

(1) a. Unless it rains, the party will be outside.
b. LF: $[_{TP3}$ O $[_{TP2}$ $[_{CP}$ unless it rains] [λ1 $[_{TP1}$ the party [will$_{C2}$ P$_1$] be outside]]]]

We can represent the meaning of the prejacent of "O" in (1) (evaluated in the actual world) as in (2).

(2) $[[TP_2]]^{w0,g}$= T iff $R{-}Q \subseteq P$
R:={w: w is accessible from w_0}, Q:={w: it rains in w}, P:={w: the party is outside in w}

Von Fintel (1994) shows that the result of applying the leastness condition to the set Q in this modal claim (given in (3)a) is equivalent to (3)b.

(3) a. $\forall Y\ (R-Y \subseteq P \rightarrow Q \subseteq Y)$
b. $Q \subseteq P' \cap \mathbf{R}$
All the worlds where it rains are **the accessible worlds** where the party is **not** outside.

The problem with (3)b is that the accessibility relation appears on the wrong side. If the relevant accessibility relation is, for example, epistemic, then (3)a entails that every world where it rains is a world that is compatible with what is known. That is too strong. There might be worlds where it rains and the Earth is flat and those are not compatible with what is known.

The result of negating alternatives with "O" is given in (4), which is the desired result ("O" also asserts its prejacent, but right now we are focusing only on the result of negating alternatives).

(4) $Q \cap \mathbf{R} \subseteq P'$
All **accessible worlds** where it rains are the worlds where the party is **not** outside.

Here is the reason why "O" and "leastness" give different results. All modal claims that are formed by substitution of the original subtracted set R by its superset are indeed entailed by the original modal claim. However, they are not the only ones that are entailed. It can happen that subtracting a set of worlds will give us a modal claim with an empty set as the restrictor. This modal claim is entailed by the original one, but this subtracted set does not have to be a superset of R. We can demonstrate this scenario on the following model (5). A modal claim (6) is true in this model.

(5) $U{:=}\{a,b,c,d,e\}$, $R{:=}\{a,b,c\}$, $Q{:=}\{b,d\}$, $P{:=}\{a,c,e\}$

(6) $R-Q \subseteq P \Leftrightarrow \{a,c\} \subseteq \{a,c,e\}$

Let's consider an alternative modal claim where the subtracted set is $\{a,b,c\}$ (7). This universal claim is true, because its restrictor is empty.

(7) $R-\{a,b,c\} \subseteq P$

The leastness condition tells us that if the resulting alternative is true, then the new subtracted set is a superset of the original one. Thus it should be the case that $\{b,d\} \subseteq \{a,b,c\}$, but it is not true. Therefore, some of the resulting modal claims are entailed by the original one, but the subtracted set is not a superset of the original one.

The actual result of negating all of the alternatives, except for the ones that are already entailed by the original modal claim (the result of applying "O" – again, ignoring the asserted prejacent) is given in (8).

(8) $\forall Y\ [((R-Y) \subseteq P) \rightarrow ((R-Y) \subseteq (R-Q))]$

The formula says that if the quantificational claim is true, then the entire new restrictor is a subset of the original restrictor (because the universal quantifier is downward entailing on its first argument). We can simplify this formula.

(9) Step 1: The left side inside the square brackets:
$R-Y \subseteq P = P' \subseteq (R-Y)'$ by contraposition
$= P' \subseteq (R' \cup Y)$ by DeMorgan's law
$= (P' \cap R) \subseteq Y$ by the following equivalence: for any A, B:
$A \subseteq (B \cup C) = A \cap B' \subseteq C$

(10) Step 2: The right side inside the square brackets:
$(R-Y) \subseteq (R-Q) = (R-Q)' \subseteq (R-Y)'$ by contraposition
$= (R' \cup Q) \subseteq (R' \cup Y)$ by DeMorgan's law
$= ((R' \cup Q) \cap R) \subseteq Y$ for any A, B: $A \subseteq (B \cup C) = A \cap B' \subseteq C$
$= ((R' \cap R) \cup (Q \cap R)) \subseteq Y$ by distributive laws

(11) Step 3: Putting the results together:
$\forall Y \, ((P' \cap R) \subseteq Y \rightarrow ((R' \cap R) \cup (Q \cap R)) \subseteq Y)$[9] =
$((R' \cap R) \cup (Q \cap R)) \subseteq (P' \cap R)$ $\Rightarrow$ because the universal quantifier is DE on its first argument
$(Q \cap R) \subseteq (P' \cap R)$ = All accessible worlds where it **rains** are worlds where the party is **not** outside.
This is the desired result.

The same result is predicted if *only* negates all of the alternatives for a negative conditional clause. Thus (12) is predicted to have the following truth-conditions.

(12) Only if it does not rain, will the party be outside.

(13) $[[(12)]]^{w0,g}$= T iff **$(Q \cap R) \subseteq (P' \cap R)$** where R:={w: is accessible from w_0}, Q:={w: it rains in w}, P:={w: the party is outside in w}

[9] The following equivalence is used here: for any sets A and B: $\forall Y \, (A \subseteq Y \rightarrow B \subseteq Y) = B \subseteq A$

Cointensional questions, fragment answers, and structured meanings[1]

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Abstract. I discuss 'cointensional questions', questions which appear to have the same sense as each other, e.g. *how many fives ten contains* and *how many times ten contains five*. Fragment answers are sensitive to the distinction in form between these questions: the first of these can be answered by *two* but not *twice*, and vice-versa for the second. I argue that this casts light on the identity condition in (clausal) ellipsis, and in particular, requires a semantics for questions and focus which is more structured than propositional/Hamblin alternatives. Building on a proposal in Krifka (2006), I propose that the *backgrounds* of short answers must be in a subset relation to the background of their antecedent questions. I show that this proposal makes additional welcome predictions, capturing so-called 'inheritance of content' effects in clausal ellipsis.

Keywords: fragment answers, ellipsis, identity in ellipsis, structured meanings, questions, focus, inheritance of content

1. Introduction

This paper considers the data in (1)–(4).

(1) Q: How many signals did the machine send?
  a. (i) It sent TWO signals. (ii) TWO (signals).
  b. (i) ?It sent a signal TWICE. (ii) *TWICE.

(2) Q: How many times did the machine send a signal?
  a. (i) ?It sent TWO signals. (ii) *TWO (signals).[2]
  b. (i) It sent a signal TWICE. (ii) TWICE.

(3) Q: How often did the train take on water?
  a. (i) It took on water TWICE. (ii) TWICE.
  b. (i) ?It took on water in TWO PLACES. (ii) ?*In TWO PLACES.

(4) Q: In how many places did the train take on water?
  a. (i) ?It took on water TWICE. (ii) *TWICE.
  b. (i) It took on water in TWO PLACES. (ii) In TWO PLACES.

The questions in (1) and (2) seem to have the same sense: assuming a machine that sends signals sequentially, then if one knows the answer to (1), one knows the answer to (2), and vice versa. The same is true, assuming a train that makes a straight journey from A to B and only stops at any water stop once, for (3) and (4). I will call such pairs of questions *cointensional.*

[1]Thanks to reviewers for and attendees at SuB 21 for helpful comments. All errors are mine.

[2]Note that *two* on its own is not ungrammatical here if it can be interpreted as *two times*. I pick *two* because of the existence of *twice*, which blocks *two times* (or at least makes the latter unnatural).

This paper seeks to explain a mystery posed by cointensional questions, namely the asymmetry between the (i) answers – 'full' or clausal answers – and the (ii) answers, variably called in the literature 'short answers', 'term answers' or 'fragment answers'. The acceptability of the (i) answers, in all cases, shows that it is possible (if sometimes mildly degraded) to answer a question 'indirectly' with a full clausal answer – that is, with an answer which does not match the antecedent question in form, but which nevertheless 'answers' the question in some broader sense. However, this possibility is not open to the fragment answers in (ii). It is ungrammatical, as the diacritics in (1)–(4) indicate, to use a fragment answer to answer a question 'indirectly', even if the corresponding full answer makes a coherent contribution to the discourse, and even if the answer to the question is (intuitively) reconstructable from the fragment.

The paper considers two main theoretical issues: the nature of the link between fragment answers and clausal answers, and the proper analysis of questions and focus structures. Many analyses of fragment answers, so-called sententialist analyses (e.g. Morgan (1973); Merchant (2004); Reich (2007); Weir (2014b) a.o.), propose to derive fragment answers directly from the clausal answers via a process of clausal ellipsis; roughly speaking, deleting everything in the clausal answer except for a focused constituent (or a constituent containing the focus; for syntactic restrictions on this process, see Merchant (2004); Krifka (2006); Weir (2014b, 2015)). By contrast, nonsententialist analyses (e.g. Stainton (1998, 2006a, b); Ginzburg and Sag (2000); Culicover and Jackendoff (2005); Jacobson (2016) a.o.) propose that short answers are generated 'directly', without accompanying sentential structure.

(5) How many times did the machine send a signal?
  a. TWICE. (nonsententialist)
  b. ~~The machine sent a signal~~ TWICE. (sententialist)

There is a considerable amount of syntactic support for sententialist analyses, at least in clear-cut cases of answers to linguistically-expressed questions, such as those in (1)–(4).[3] However, on the face of it, data like those in (1)–(4) pose a problem for sententialist analyses; if the fragment answers are reductions of the clausal answers, why are some fragment answers unacceptable when their corresponding clausal answers are acceptable?

This paper locates the problem in the semantic identity condition that is operative in clausal ellipsis. The proposal is that the kind of semantic identity that is required between an elided clause and its antecedent is such as to enforce the kind of form-matching effects shown in (1)–(4). It will furthermore be shown that the kind of semantic identity condition required implies that questions and focus structures, at least at some level of their interpretation, must be more structured or 'categorial' in their meaning than a denotation based on propositional alternatives/Hamblin sets, as proposed by Hausser (1983); von Stechow (1990); Krifka (2001, 2006); Jacobson (2016) a.o. Furthermore, the analysis will be extended to capture two further phenomena associated with fragment answers, and clausal ellipsis more generally (e.g. sluicing). Firstly, the analysis is extended to 'inheritance of content' effects (Chung et al. (1995); Romero

[3] Antecedentless fragments, such as those discussed in Stainton (2006b) – e.g. *Fire!* or *A coffee, please* – pose further complications and may not ultimately be amenable to a sententialist analysis, as Merchant (2010) discusses, though see Weir (2014b):ch. 3 for a contrary view. I put these cases aside in this paper.

(1998); Barros (2013); Weir (2014a, b); Jacobson (2016) a.o.) illustrated in (6), (7); fragment answers (*John and Bill* and *Jane Austen* respectively below) obligatorily 'inherit' restrictions from the antecedent sentence, while this does not necessarily occur in the full answers:

(6) (Jacobson (2016)'s (14), adapted)
Which math students left the party early?
a. John and Bill left the party early, but they're not math students.
b. John and Bill, #but they're not math students.

(7) (from Weir (2014b):60, originally from Jeremy Hartman p.c.)
Which Brontë sister wrote *Emma*?
a. Jane Austen wrote *Emma*, you idiot.
b. #Jane Austen, you idiot. (entails that Jane Austen is a Brontë sister)

Secondly, the analysis also captures the (related) fact that, while a fragment can provide a 'more specific' (i.e. with a more specific NP restriction) answer than the question contains (8), the inverse (9a, b) is not possible, even if the full clausal answer is acceptable (9c, d). See Barros (2013) for discussion of similar facts with respect to sluicing.

(8) Which pastries did John eat? – Some croissants.

(9) Which pastries did John eat?
a. #Nothing.
b. #All the food on the table.
c. He ate nothing.[4]
d. He ate all the food on the table.

The paper proceeds as follows. Section 2 lays out some of the background issues: why a sententialist account of fragment answers is to be preferred on syntactic grounds, and some existing approaches to the semantic identity condition on clausal ellipsis. Section 3 discusses how the data discussed above pose a problem for many extant theories of this semantic identity condition. Section 4 argues that these facts should not be captured by reference to a syntactic or LF-isomorphism condition on ellipsis (such as those proposed by Chung (2013); Merchant (2013); Griffiths and Lipták (2014); Thoms (2015) a.o.). Section 5 makes the proposal that the semantic condition on clausal ellipsis must make reference to a structured semantic object, building on proposals by Krifka (2006), while section 6 provides a technical implementation of how this is done in the syntax. Section 7 proposes a modification to Krifka's proposal, which maintains the essential feature of capturing the data in (1)–(4), and has the additional benefit of capturing the 'inheritance of content' effects discussed above. Section 8 concludes.

[4] *He didn't eat anything* is better here, but the fragment answer *anything* is out for independent reasons (as the putatively elided clause, *he ate x*, contains no negator to license the NPI). The clausal answer in (9c) is nevertheless grammatical.

2. Fragments, ellipsis, and the semantic antecedence condition

I start from the position that, at least in question-answer sequences like that in (10), the fragment answer is derived via clausal ellipsis as in (11); and concretely, I adopt Merchant (2004)'s proposal that the fragment moves to a left-peripheral position prior to ellipsis of the rest of the clause (although we will see a refinement of this position in sections 4 and 6).

(10) What did John eat? – Chips.

(11) a. ~~John ate~~ chips.
b. $[_{CP}$ Chips$_1$ ~~$[_{TP}$ John ate $t_1]$~~$]$

Clausal structure can be diagnosed, for example, by the presence of binding and Case connectivity effects in the fragment (i.e. the fragment shows the binding and Case properties that it would in the full clause; Merchant (2004)). The existence of a movement dependency can be diagnosed by the existence of 'stranding' effects; for example, in languages in which prepositions must obligatorily be pied-piped along with their arguments, prepositions are also obligatory in the corresponding fragment answers (Merchant (2001, 2004)'s P-stranding generalization; see also Weir (2014b)). Space precludes a detailed defense of the sententialist position over 'bare' or 'subsentential' analyses, in which fragment answers are generated without clausal structure; on the basis of the evidence presented by the above authors, I assume that clausal ellipsis is indeed implicated in the creation of fragment answers.[5]

As in all cases of ellipsis, some kind of matching or identity relation must hold between the elided clause and some antecedent. One familiar candidate for such a condition is Merchant (2001)'s e-GIVENness:

(12) a. A clause may be elided if it is e-GIVEN.
b. A clause A is e-GIVEN if there is an antecedent clause E such that F-clo(A) $\Longleftrightarrow$ F-clo(E).
c. The focus closure (F-clo) of a clause is the denotation of that clause with all focused elements replaced by variables, and all variables (that is, traces plus focused elements which have been replaced) having been existentially closed.

This would rule in ellipses such as (11b) by matching two IPs which both contain existentially closed traces in object position:

(13) a. What did $[_{IP}$ John eat t$]$? – Chips $[_{IP}$ John ate t$]$
b. $\exists x$. John ate $x \Longleftrightarrow \exists y$. John ate y

This condition is likely too liberal; recent work on clausal ellipsis (e.g. Reich (2007); Ander-

[5]The claim made in this paper can be understood as a weaker, conditional one; *if* one accepts a sententialist/ellipsis view of fragments, *then* one will also have to accept a semantic condition on clausal ellipsis along the lines proposed here. It should be noted also that one of the main proponents of the nonsententialist view, Robert Stainton (e.g. Stainton (1998, 2006a, b)), has as his main concern antecedentless or discourse-initial fragments, and accepts that in question-answer sequences, fragments may be derived elliptically from full clauses.

Bois (2010, 2014); Barros (2014); Weir (2014a, b); Collins et al. (2015)) has been converging on the position that clausal ellipsis cannot find its antecedent simply anywhere in the preceding discourse, but must rather find its antecedent in the Question under Discussion (Roberts, 1996).[6] Reich (2007) proposes, for example, that the focus-semantic value of an elided clause, understood as a set of propositional alternatives (Rooth, 1985) must be equal to the value of the Question under Discussion, also understood as a set of propositional alternatives (Hamblin denotation for questions):

(14) What did John eat? — ~~John ate~~ chips.
 a. ⟦QUD⟧ = ⟦What did John eat?⟧ = {John ate chips, John ate cake, ...}
 b. ⟦John ate [chips]$_{\text{F}}$⟧$^{\text{f}}$ = {John ate chips, John ate cake, ...}
 ⟦QUD⟧ = ⟦John ate [chips]$_{\text{F}}$⟧$^{\text{f}}$, so ellipsis is licensed.

I will assume, again without much discussion, that the Question under Discussion (or something very like it, such as the concept of 'live issue' in Inquisitive Semantics) is the anaphoric 'target' for the identity relation in clausal ellipsis; the reader is referred to the authors above for support for this position.

3. The problem for propositional alternatives

Many of the semantic accounts founder on the data presented in (1)–(4); the examples in (1) and (2) are repeated here:

(15) Q: How many signals did the machine send?
 a. (i) It sent TWO signals. (ii) TWO (signals).
 b. (i) ?It sent a signal TWICE. (ii) *TWICE.

(16) Q: How many times did the machine send a signal?
 a. (i) ?It sent TWO signals. (ii) *TWO (signals).
 b. (i) It sent a signal TWICE. (ii) TWICE.

The problem here is that, on a Hamblin-alternatives view of questions (and of focus), the questions in (15) and (16) above denote the same sets of sets of worlds, and so do the focus values of the answers.

(17) a. ⟦How many signals did the machine send?⟧
 b. ⟦the machine sent [two]$_{\text{F}}$ signals⟧$^{\text{f}}$
 c. $\{p \mid \exists d.p = \lambda w'.$ the machine sent d-many signals in $w'\}$
 d. {the machine sent one signal, the machine sent two signals, ...}
 e. {the machine sent a signal once, the machine sent a signal twice, ...}
 f. $\{p \mid \exists d.p = \lambda w'.$ the machine sent a signal d-many times in $w'\}$
 g. ⟦the machine sent a signal [twice]$_{\text{F}}$⟧$^{\text{f}}$
 h. ⟦How many times did the machine send a signal?⟧

[6] AnderBois (2010, 2014)'s argument that clausal ellipsis is anaphoric to the 'live issue' can be seen as a variant on this, although the implementation in terms of Inquisitive Semantics is rather different.

The key point is that if the machine sent two signals, then it also sent a signal twice; if the machine sent a signal three times, then it also sent three signals; and so on. If we understand questions and focus-semantic values to consist of sets of sets of worlds (propositional alternatives), then each of (17a–h) is the same object: the same set of sets of worlds. But this is a problem for the semantic conditions reviewed in section 2. These semantic conditions rely on a characterization of focus-alternatives as being sets of propositions; if the sets of propositions denoted by two clauses (such as *the machine sent* TWO *signals* and *the machine sent a signal* TWICE) are identical, then from the point of view of these semantic identity conditions, 'mismatch' answers should be possible, such as the below discourse. Here Reich (2007)'s condition, where the QUD has to be identical to the focus value of the answer, is used to illustrate; but the same problem will afflict any condition that uses propositional alternatives in its formulation.

(18) How many signals did the machine send? — *~~The machine sent a signal~~ TWICE.

(19) $[\![$How many signals did the machine send?$]\!]$ = $[\![$the machine sent a signal $[\text{twice}]_F]\!]^f$
so ellipsis should be licensed in (18), contrary to fact.

One might initially think that the examples have not been constructed carefully enough; perhaps the set of worlds in which the machine sends two signals is not quite the same set of worlds in which the machine sends a signal twice. (Perhaps the machine can send two signals simultaneously.) Such a semantic difference between the two answers would be enough to cause the semantic conditions discussed above not to be met. However, we can illustrate the problem in general terms by using mathematical examples, such as (20), (21).

(20) Q: How many fives does ten contain?
a. (i) Ten contains TWO fives. (ii) TWO (fives).
b. (i) ?Ten contains five TWICE. (ii) *TWICE.

(21) Q: How many times does ten contain five?
a. (i) ?Ten contains TWO fives. (ii) *TWO (fives).
b. (i) Ten contains five TWICE. (ii) TWICE.

Because mathematical truths are assumed to hold at all possible worlds, we can be sure that the question and all of the answers above denote the same sets of sets of worlds (that is, the singleton set containing the set of all possible worlds). Despite the fact that the questions and the focus values of the answers in (20) and (21) are all cointensional, the same problem recurs: 'mismatches' of this sort are forbidden, as shown above.

It should be noted that this is not quite the same problem as classic cases of hyperintensionality, which demonstrate that a possible-worlds semantics for propositions is insufficient; e.g. the failure of (22a) to entail (22b), even though both of the clauses embedded under 'know' should denote the same sets of sets of worlds (i.e. the singleton set containing the set of all possible worlds).

(22) a. Little Johnny knows that two plus two makes four.
b. Little Johnny knows that the square root of 169 is 13.

The examples in (1)–(4) differ from examples like those in (22) because the questions, and their answers, in (1)–(4) really do appear, at least on the face of it, to have the same sense. For example, they can be substituted, *salva veritate*, under a verb like *know* in a way that the mathematical statements in (22) cannot.

(23) a. John knows how often the train took on water.
b. John knows in how many places the train took on water.[7]

(24) a. John knows how many fives ten contains.
b. John knows how many times ten contains five.

Despite the fact that these questions and answers seem in some way to share the same sense, that identity does not suffice for ellipsis matching in (1)–(4). One obvious way to explain the failure of ellipsis in these examples would be to suggest that there is a *syntactic* difference between the elided clause and the antecedent, combined with the idea that the identity condition in ellipsis is (partially or wholly) syntactic in nature. In the next section I will argue that, even if one agrees that there is a syntactic component to ellipsis identity, this will not suffice to solve the problem that cointensional questions pose.

4. Not due to syntactic isomorphism or LF-parallelism

On the face of it, the alternations discussed here look rather similar to other cases that have been discussed in the literature, where the propositional semantics of the antecedent and elided clauses are the same but the syntax is different. Examples include voice mismatches (Merchant, 2013) and argument structure mismatches (Chung, 2013; Merchant, 2013). In such cases also, clausal ellipsis (sluicing, fragments) is not licensed.

(25) *Voice mismatches* (Merchant, 2013)
a. *Someone ate the cake, but we don't know by who ~~the cake was eaten~~.
b. *Who ate the cake? — By John ~~the cake was eaten~~.
c. *The cake was eaten, but we don't know who ~~ate the cake~~.

(26) *Argument structure mismatches*
a. *It's known that they sent someone a silly message, but it's unclear to who ~~they sent a silly message~~. (Chung, 2013: ex. 6)
b. *They embroidered something with peace signs, but I don't know on what ~~they embroidered peace signs~~. (Merchant, 2013: ex. 43)

[7]One might again contest such examples by saying that there are situations which tease them apart; for example, if there is only one water stop on the track (which the train might have stopped at several times going forward and back), (23b) might be true (John knows there's only one place), but (23a) false. Again, the mathematical example in (24) is given to show that the problem is a general one, independent of the problems that might be found for specific examples.

It has been argued that the failure of such mismatches is due to a syntactic isomorphism condition in ellipsis. For example, Chung (2013) proposes that elided clauses must be identical to their antecedents in argument structure and the presence of Case-assigning heads. I do not want to argue against a syntactic identity condition in ellipsis (over and above the semantic identity condition to be developed in this paper) to capture these data; the cases discussed by Chung and Merchant are convincing in this respect. But I believe that this is not what is going wrong in the examples in (1)–(4). Consider the antecedent and ungrammatical elided clause (assuming movement of the fragment) that cause problems in (1), for example.

(27) a. [$_{CP}$ How many signals$_i$ [$_{TP}$ the machine [$_{vP}$ [$_{VP}$ send t$_i$]]]]]
b. *[$_{CP}$ Twice$_i$ [$_{TP}$ the machine [$_{vP}$ [$_{VP}$ send a signal] t$_i$]]]]

We can see two potential 'mismatches' here; firstly, the antecedent has a trace (of *how many signals*) where the elided clause has an indefinite (*a signal*); and the elided clause has a trace (of *twice*) where the antecedent has nothing. However, these cannot be what is ruling this question-answer pair out; similar 'mismatches' do not trouble clausal ellipsis in other cases. As discussed by (Merchant, 2001: 202ff), there are in general many cases where an antecedent for clausal ellipsis contains a trace in a position where a trace could not be in the elided clause. Merchant's strategy to deal with such cases is to assume that a pronoun is present in the ellipsis site, and it seems difficult to credit an alternative to this in cases such as the below.

(28) The FBI knows [which truck$_i$ they rented t$_i$], but figuring out [from whom$_j$ ~~they rented **it**$_j$~~] has proven difficult. (Merchant, 2001: 206)

(29) What did he eat t$_i$, and why ~~did he eat **it**$_i$~~?

(30) A: That natto, he ate t$_i$. B: Yes – with chopsticks ~~he ate **it**$_i$~~

The point can be generalized with indefinites in predicative position:

(31) Such a man$_i$, John might become t$_i$.
a. Tom, too. (=Tom$_j$ ~~t$_j$ might become **such a man**~~ too)
b. ...but I couldn't tell you when$_j$ ~~he might become **such a man** t$_j$~~

(32) What kind of man might John become t$_i$?
And when$_j$ ~~might he become **such a man** t$_j$~~?

Such cases indicate that a trace can clearly antecede something contentful in an elided clause.[8] Moreover, (31) and (32) appear to indicate that the contentful constituent in the elided clause can potentially be a full indefinite, not 'merely' a pronoun, given the degraded nature of (33b) on the relevant reading:

[8] One could argue that the moved phrase in the antecedent clause is subject to reconstruction, allowing matching; but then this should be available in cases like (27) as well.

(33) What kind of man might John become?
   a. And when might he become such a man?
   b. ??And when might he become one?
      (only: when might he become a man, not: when might he become such a man)

Any putative ban on a trace anteceding a non-trace cannot therefore account for the badness of the cases under discussion here, as there is evidence against the existence of such a ban. The 'inverse' problem – that a trace is present in the elided clause that is not present in the antecedent – is also present in the example in (27).[9] But this also is not generally a problem for clausal ellipsis; this is simply so-called 'sprouting'.

(34) He's dancing, but I don't know [with who]$_i$ ~~he's dancing t$_i$~~.

(35) He ate natto. — Yes, [with chopsticks]$_i$ ~~he ate natto t$_i$~~.

Examples like (34) and (35) show that we cannot locate the problem simply in the fact that the elided clause contains a trace that the antecedent does not contain.

A somewhat different kind of syntactic isomorphism has been proposed by many authors in the form of '(LF) Parallelism' (Fiengo and May (1994); Fox and Lasnik (2003); Griffiths and Lipták (2014); Thoms (2015) a.o.). Under this conception, what is relevant in ellipsis identity is syntactic identity at LF up to variables, and correspondence at LF between the scopes of ellipsis remnants and of their antecedents; any variable-binding relationships should be identical between antecedent clause and elided clause.[10] This captures, for example, the fact that the indefinite correlates of *wh*-remnants in sluicing take wide scope, in parallel with the *wh*-phrase:

(36) Most people ate something, but I don't know what ~~most people ate t~~.

(37) a. Antecedent LF: something 1 [most people ate t_1]
   b. Elided clause: what 1 [most people ate t_1]

The LFs of the antecedent and elided clause are identical, up to the identity of the binders, and so ellipsis is licensed. It might be thought that an LF Parallelism constraint of this sort can explain why the mismatch cases in (1)–(4) are ungrammatical. In particular, the variable-binding relations in 'mismatch' cases differ: in (38) a trace is being bound in object position in the antecedent but in adjunct position in the elided clause, and vice versa in (39).

[9]This is true if we assume movement of the fragment. This view will be discussed and (partially) revised below and in section 6. However, the key point here is just that arguments and adjuncts can 'sprout' under ellipsis, without any corresponding antecedent, so that by itself should not cause a problem for the 'mismatch' cases under discussion here.

[10]The term 'Parallelism' is somewhat ambiguous. The literature is agreed that, as a matter of *interpretation*, elided clauses must have the same scope relations as their antecedents. What is not clear is whether this is enforced only at the level of semantic interpretation, or whether it is a *syntactic* constraint at LF, concerning the positions of variables and their binders. (An indefinite could for example have a 'wide-scope' interpretation by dint of being the only scope-bearing element in the sentence, without actually taking syntactic scope at LF.) Here I am discussing this latter understanding of Parallelism as a basically syntactic (LF-level) constraint.

(38) a. How many signals 1 [the machine [$_{\text{vP}}$ [$_{\text{VP}}$ send t_1]]]
b. Twice 1 ~~[the machine [$_{\text{vP}}$ [$_{\text{VP}}$ send a signal] t_1]]~~

(39) a. How often 1 [the machine [$_{\text{vP}}$ [$_{\text{VP}}$ send a signal] t_1]]
b. Two signals 1 ~~[the machine [$_{\text{vP}}$ [$_{\text{VP}}$ send t_1]]]~~

There are two reasons not to believe that this is the problem in the cases under discussing here, however. The first is that the examples in (3) and (4), repeated below, seem to involve binding into the same position, namely a vP-level adjunct; so it is not clear that a failure of binding parallelism alone should be the culprit.

(40) a. How often did the train take on water? – *In two places ~~the train took on water~~.
b. In how many places did the train take on water? – *Twice ~~the train took on water~~.

(41) a. How often 1 [the train [$_{\text{vP}}$ [$_{\text{VP}}$ took on water] t_1]]
b. In two places 1 [the train [$_{\text{vP}}$ [$_{\text{VP}}$ took on water] t_1]]

The second counterargument is that it is not clear that fragments move at LF in the way that the LF Parallelism account would suggest. Weir (2014b, 2015) provides a number of arguments that fragments do move (in the way proposed by Merchant (2004) and discussed in section 2) – but only at PF, not at LF. The most important of these arguments is the availability of NPI fragments (see also den Dikken et al. (2000); Valmala (2007)).

(42) a. I know what John did buy, but what didn't he buy? — Any wine.
b. Which of these computers should I not touch? — Any of them!

As NPIs must be in the scope of their licensor at LF, and never take wide scope, then the LF movement which Parallelism accounts appeal to is not available for fragments like (42). It is therefore not clear that Parallelism is to be correctly understood as a *syntactic* constraint on ellipsis. However, I wish to argue for a version of the leading idea of the LF Parallelism approach – that a condition on ellipsis is that lambda abstractions in the antecedent and the elided clause must 'match' in some way. However, I argue that this is not to be located in the syntax, but rather in a more structured *semantics* for questions and focus structures.

5. The solution: congruence with structured meanings

In this section I will argue for two main conclusions:

(a) Questions, and focus structures, must be understood (at some level of semantic representation) to have a more structured, 'categorial'-style denotation than Hamblin sets of propositional alternatives, as in for example Hausser (1983); von Stechow (1990); Krifka (2001, 2006); Jacobson (2016).

(b) It is this structured meaning, or a part of it, which (the semantic component of) the identity condition on clausal ellipsis makes reference to.[11]

The proposal I would like to make here builds directly on a proposal in Krifka (2006). Krifka proposes that questions, and focus structures (e.g. answers to questions), have the structured denotations shown in (43) and (44) below (after Krifka's (77, 78) respectively).[12]

(43) $[\![\text{who}_i \text{ John introduced } \text{t}_i \text{ to Sue}]\!]$
$= \langle \text{PERSON}, \lambda x.\text{introduced}(\text{sue})(x)(\text{john})\rangle$
where PERSON is the alternatives that the question word can range over.

(44) $[\![\text{John introduced } [\text{Bill}]_{\text{F}} \text{ to Sue}]\!]$
$= \langle \text{bill}, A, \lambda x.\text{introduced}(\text{sue})(x)(\text{john})\rangle$
where A is the focus alternatives (in the sense of Rooth (1985), and possibly restricted by context) to the focused term (i.e. here $A = \text{ALT}([\![\text{Bill}]\!]) = \{\text{Tom, Mary, Harry}, \ldots\}$)

Following the literature on structured-meaning approaches to focus and questions, call the lambda-terms in (43) and (44) the *backgrounds* of the question and the focus structure. Given these denotations, Krifka proposes the question-answer congruence condition in (45) (Krifka's (79), adapted).

(45) A question-answer pair $\langle W, B\rangle$ — $\langle F, A, B'\rangle$ is congruent iff:
$B = B'$ and $W \subseteq A$ (or $W = A$).
If congruent, the answer asserts $B(F)$.

Furthermore, Krifka states that 'the identity of backgrounds allows for short, or term answers, in which the background of the answer is deleted' (p. 130). The requirement that the backgrounds – that is, the lambda abstractions created by abstracting over the *wh*-term in the question and the focused term in the answer, respectively – must be identical is not met in the case of the cointensional questions. Crucially, even though the intensions/senses of cointensional questions are the same, their structured meanings are not; in particular, the backgrounds in the 'mismatch' cases are different, if we assume that the background in a case like (46) is a lambda-abstraction over signals, and the background in a case like (47) is a lambda-abstraction over intervals of time.

[11] This formulation contains two caveats. Firstly, as discussed in section 4, I do not want to make the strong assertion here that the identity condition on ellipsis is purely semantic; there may also be a syntactic component to it, as proposed in Chung (2013); Merchant (2013) a.o. Secondly, the proposals made here are made only for *clausal* ellipsis, and not for other forms of ellipsis such as verb phrase ellipsis, which seem to have different antecedence conditions (see e.g. discussion in AnderBois (2010); Weir (2014b)).

[12] These denotations have been adapted from the originals in two ways. Firstly, the interpretations Krifka gives to these structures is not strictly speaking the structured denotation itself, but rather the speech act which contains this structured denotation as content; but I have suppressed this distinction here (and in subsequent discussion). Secondly, and more importantly, Krifka presents the denotation in (44) as the interpretation of a logical form which contains movement of the focused phrase; however, as discussed in section 4, I do not want to assume that fragments (or foci in general) move at LF in this way. I will discuss the matter of how exactly the lambda term in (44) should be created in section 6; for the present I simply assume that the structured denotation in (44) can be derived in some way or another.

(46) Question: How many signals did the machine send?
Background: λx. the machine sent x, x a signal

(47) Question: How many times did the machine send a signal?
Background: λt. the machine sent a signal at interval t

The corresponding focus-structures will have the same lambda abstractions as their backgrounds:

(48) Answer: The machine sent [TWO signals]$_F$.
Background: λx. the machine sent x, x a signal

(49) Answer: The machine sent a signal [TWICE]$_F$.
Background: λt. the machine sent a signal at interval t

The key point here is that if (46) is answered with (49), or (47) with (48), the backgrounds will not match. Adopting Krifka's question-answer congruence condition in (45) as a condition on clausal ellipsis therefore captures the data in (1)–(4).[13] Additional support for this comes from some cases where such 'mismatches' *are* possible. A *how many* or *how often* question does not always have to receive a numerical short answer, as long as the background of the answer is a lambda-abstraction which matches the background of the question (i.e. abstracts over a variable in the same position), as (50) and (51) illustrate.

(50) How many people came to the party? (Weir, 2014b: 79)
a. Six (people).
b. John, Paul, George, Sarah, Mary and Helen.
(background in both cases: λx. x came to the party)

(51) In how many places did the train take on water?
a. Three (places).
b. Cleveland, Albany and Springfield.
(background in both cases: λx. the train took on water in x)

6. Implementation

How do we get access to backgrounds in focus and question structures? That is, how do we create the lambda abstractions involved? Krifka proposes that this is done via movement: *wh*-words and foci move at LF, and this movement creates a lambda abstraction in the normal way (following e.g. Heim and Kratzer (1998)'s rule of Predicate Abstraction).

(52) LF: [Who 1 [did John introduce t_1 to Sue]]
Background: λx. John introduced x to Sue

[13] Krifka's proposal is actually intended to be a condition on question-answer congruence generally, not just in elliptical structures. That seems too strong, given that full clausal 'mismatches' are only mildly degraded (*How many signals did the machine send? — ?It sent a signal* TWICE), even though their backgrounds do not appear to match.

(53) LF: [Bill 1 [John introduced t_1 to Sue]]
Background: λx. John introduced x to Sue

I assume that this is indeed how backgrounds are created in *wh*-questions. However, given the evidence reviewed in section 4 that fragments do not move at LF (Weir, 2014b, 2015), I do not wish to derive the backgrounds of the answers via LF movement as such. In this section I wish to sketch a method of obtaining the same effect – i.e. the creation of a lambda abstraction over the focused phrase, but without actual syntactic movement of that phrase.[14]

I propose that a Focus head is inserted in the clausal left periphery, co-indexed with the focused phrase in the clause (see Constant (2014) for a similar recent proposal for a contrastive topic head; on the technology of focus indices, see Kratzer (1991)). This Foc head, furthermore, is endowed with an [E] feature (Merchant, 2001) which enforces the semantic condition on clausal ellipsis as a presupposition; this $\text{Foc}_{[\text{E}]}$ head has a syncategorematic interpretation when it combines with a TP, given in (54).[15]

(54) **Implementation of ellipsis condition on E-feature (to be refined)**
Let n be an index. Then,
$[\![\text{Foc}_{[\text{E}]\text{n}}\ \text{TP}]\!] = [\![\text{TP}]\!]$, iff there is an antecedent question/Question under Discussion whose background is equal to $[\![\text{n TP}]\!]$; otherwise undefined.

The interpretation of $[\![\text{n TP}]\!]$ is given by the rule of Trace Conversion (Fox, 2002):

(55) $[\![[\text{n}\ [\ldots \text{XP}_\text{n} \ldots]]]\!]$
$= \lambda x.\ [\![\ldots \text{XP} \ldots]\!]$, where the head of XP is replaced by the head the_x,
where $[\![\text{the}_x]\!] = \lambda P.\iota y.[P(y) \wedge y = x]$

So, for example, the structure in (56a) is interpreted as in (56b):

(56) a. [3 [the machine sent [two signals]$_3$]]
b. λx. the machine sent the_x signals
$= \lambda x$. the machine sent $\iota y.[\text{signal}(y) \wedge y = x]$
$\approx \lambda x$. the machine sent the signals which are x

And the structure in (57) – i.e. the structure underlying the elliptical answer *two signals* – is interpreted as shown. (The [E]-feature prompts ellipsis of the clause, as in Merchant (2001), and the focused phrase will move at PF to a left-peripheral position to escape ellipsis; see Weir (2014b, 2015) for details.)

[14] But this is not crucial for the rest of the analysis being presented here. Readers who are unconvinced by the arguments against the movement of fragments, and/or who wish to assume that foci move at LF, can continue to assume this, and can assume that focus backgrounds are created by movement (which is indeed perhaps an easier way to do it than the proposal here). What will be key, though, is the appeal to mechanisms of Trace Conversion discussed below.

[15] It may seem to be a disadvantage of the proposal that it requires the syncategorematic rule in (54). However it should be noted that Merchant (2001)'s original [E]-feature also in effect has to be interpreted syncategorematically, as Weir (2014b):319 discusses.

(57) $[\![$[Foc$_{[E]3}$ [the machine sent [two signals]$_3$]]$]\!]$
= $[\![$the machine sent two signals$]\!]$
iff there is an antecedent question/Question under Discussion whose background is equal to [λx. the machine sent the signals which are x]

The presupposition in (57) will be met if the antecedent question has the background 'λx. the machine sent the signals which are x', but not if it has the background 'λt. the machine sent the signals at interval t', capturing the data in (1)–(4).

7. Refining the matching condition

Krifka's matching condition therefore captures the data this paper began with. I wish here, however, to propose a modification to Krifka's proposal, while retaining the core idea that it is the backgrounds of question and answer which are important in clausal ellipsis. The necessary refinement comes from question-answer pairs such as the below, from Jacobson (2016).

(58) Which math students came to the party?
a. John and Bill came to the party, but they're not math students.
b. John and Bill (#but they're not math students)

As can be seen, the full clausal answer in (58a) does not commit the speaker to John and Bill's being math students. That is, the restriction of the question is not necessarily inherited in a full clausal answer. By contrast, in a fragment answer, the restriction of the question is obligatorily inherited (and see Chung et al. (1995) for similar data for sluicing).

The question-answer congruence proposal made in Krifka (2006) does not quite capture this. Let us suppose first that the restrictions in the questions and answers are encoded in the way that Trace Conversion would deliver, as below:

(59) a. Q: Which math students came to the party?
b. B: λx. the math students who are x came to the party

(60) a. A: [John and Bill]$_F$ came to the party
b. B': λx. John and Bill, who are x, came to the party

Saying that these backgrounds have to match is too strong a condition. This would require that the partial function which maps math students to True if they came to the party and False otherwise, is identical to the partial function which maps {John, Bill} to True if they came to the party and False otherwise; that is, it would entail not merely that John and Bill are math students, but that they are the only math students. To avoid this problem, we could try removing the restriction within the lambda term, making the backgrounds in both cases 'λx. x came to the party', but we then need to understand why the short answer in (58b) is restricted to math students. The second clause of Krifka's condition, which states that the range of the *wh*-word in the question must be a subset of the focus-alternatives of the focused term in the answer ('$W \subseteq A'$' in (45)), does not quite capture this; in fact it is not clear that we wish to impose this precise condition on question-answer congruence, at least not in this form, given the availability of generalized quantifiers as the focused phrase in answers:

(61) Which pastries did John eat? — (A lot of croissants, but) fewer than three danishes.

Here, the set of alternatives to the focused phrase (*fewer than three danishes*) presumably contains generalized quantifiers, as in (62).

(62) $\text{ALT}(\llbracket\text{fewer than three danishes}\rrbracket)$
$= \{\llbracket\text{fewer than three croissants}\rrbracket, \llbracket\text{more than three danishes}\rrbracket, \llbracket\text{five croissants}\rrbracket, \ldots\}$

The contents of the set in (62) are of the wrong type for the '$W \subseteq A'$' condition to be met; in (61), this would require the set of entities denoted by $\llbracket$pastries$\rrbracket$ to be a subset of the set in (62), but (62) is a set of generalized quantifiers, not entities.

I propose a solution to the above which comprises two main ingredients. Firstly, I assume that backgrounds of questions and of focus structures are indeed structured in the way in which Trace Conversion would deliver, that is, they are partial functions of the kind in (59), (60). Secondly, I propose that the background-matching condition on clausal ellipsis is as in (63).

(63) **Background-matching condition on clausal ellipsis (final version)**
Given a question with background Q and an answer with background A, the answer can be elided (up to the focused phrase) only if $A \sqsubseteq Q$.

Where '$\sqsubseteq$' is a notion of generalized entailment defined over functions:

(64) $A \sqsubseteq B \iff \forall x.A(x) \rightarrow B(x)$

It is probably easiest to understand this definition in terms of set talk; the definition states that, understood extensionally as sets, the background of the answer must be a subset of the background of the question. This can then be encoded in the Foc head/[E]-feature as follows, a revision of (54):

(65) **Implementation of ellipsis condition on E-feature (final version)**
Let n be an index. Then,
$\llbracket\text{Foc}_{[\text{E}]\text{n}}\ \text{TP}\rrbracket = \llbracket\text{TP}\rrbracket$, iff there is an antecedent question/Question under Discussion with background B such that $\llbracket\text{n TP}\rrbracket \sqsubseteq B$; otherwise undefined.

Such a condition captures the cases discussed by Jacobson (2016). The backgrounds of the question and answer are as shown in (66) and (67) respectively:

(66) Question: Which math students came to the party?
Background: λx. the math students who are x came to the party

(67) Answer: [John and Bill] ~~came to the party~~
Background: λx. John and Bill who are x came to the party

If it is a condition on clausal ellipsis that the elided clause's background must be a subset of the antecedent question – i.e. the background in (67) is a subset of the background in (66), or equivalently, satisfying the predicate in (67) entails satisfying the predicate in (66) – then this forces John and Bill to be math students. The same effect can be seen in the below case, which is simply ungrammatical (from Weir (2014b):60, originally due to Jeremy Hartman p.c.)

(68) Which Brontë sister wrote *Emma*?
a. Jane Austen wrote Emma, you idiot.
b. #Jane Austen, you idiot.

(69) Background of question: λx. the Brontë sister who is x wrote *Emma*
Background of answer: λx. Jane Austen who is x wrote *Emma*
Background of A $\not\sqsubseteq$ background of Q, so ellipsis is not licensed.

Such a subset condition also captures the fact that one can move from 'superset' NP restrictors in a question to 'subset' restrictors in the fragment, but not vice versa, as (70) and (71) show:

(70) Q: Which pastries did John eat? (Background: λx. John ate the pastries which are x)
A: Three croissants ~~John ate~~. (Background: λx. John ate the croissants which are x)
Background of A $\sqsubseteq$ background of Q, so ellipsis is licensed.

(71) Q: Which pastries did John eat? (Background: λx. John ate the pastries which are x)
A: *Nothing ~~John ate~~. (Background: λx. John ate the thing which is x)
Background of A $\not\sqsubseteq$ background of Q, so ellipsis is not licensed.[16]

(72) Q: Which pastries did John eat? (Background: λx. John ate the pastries which are x)
A: *All the food at the buffet ~~John ate~~.
(Background: λx. John ate the food at the buffet which is x)
Background of A $\not\sqsubseteq$ background of Q, so ellipsis is not licensed.

Note in these cases that full clausal answers are possible; in other words, the problem is not that the answer is per se incoherent, but rather that some condition proprietary to short answers/clausal ellipsis is not met.

(73) Which pastries did John eat?
a. John ate NOTHING.
b. John ate ALL THE FOOD AT THE BUFFET.

[16]Note also that the condition proposed in Jacobson (2016), which proposes that the background of the question must compose with the denotation of the fragment, does not quite capture this data (although it captures the data in (66) and (68)). The fragment *nothing* (i.e. '$\lambda P.\neg\exists x.P(x)$') could compose with the question's background here (which would result in the proposition '$\neg\exists x$. John ate the pastries which are x', i.e. that John didn't eat any pastries). What goes wrong in (71) rather seems to be the fact that the backgrounds are not in the proper subset relation.

The background-matching condition proposed here is argued to be proprietary to clausal ellipsis, and so captures this asymmetry.

8. Conclusion

In this paper, I have argued that cointensional questions and their short answers pose a challenge to semantic conditions on ellipsis that work only at the level of propositional alternatives. I have argued, following Krifka (2006), that the correct account of such cases requires a structured-meaning treatment of questions and focus structures; and have proposed an implementation of a semantic matching constraint: the focus background of an answer must entail/be a subset of the background of the antecedent question.

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An attention-based explanation for some exhaustivity operators[1]

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Abstract. A well-known challenge for accounts of exhaustivity implications is the *granularity problem*: that adding a non-weakest disjunct to an utterance (e.g., “or both”) may prevent exhaustivity implications. Recent approaches to this problem apply exhaustivity operators either globally, i.e., to the disjunction as a whole, or locally, i.e., to each disjunct separately. This paper seeks to contribute to a better understanding of the operators employed in the globalist strand, which, contrary to globalists’ aims, have not thus far been given any sort of pragmatic motivation. To that end this paper demonstrates that these operators can be derived, wholly or in part, from a pragmatic theory: *Attentional Pragmatics* (Westera, 2017). The theory centers on the assumption that speakers should not only assert all relevant propositions they hold true, but also draw attention to all relevant propositions they consider possible. This assumption, suitably formalized, overcomes the granularity problem. The current paper formally derives an exhaustivity operator from Attentional Pragmatics and proves that it is in important respects conservative with regard to existing operators.

Keywords: exhaustivity, Hurford disjunction, granularity, Attentional Pragmatics, globalism/localism, innocent exclusion, minimal worlds.

1. Introduction

Adding a non-weakest disjunct can affect the exhaustivity implications of an utterance:

(1) A: Who (of John, Mary and Bill) is at the party?
  a. B: John is there. *(implied: not Mary, not Bill)*
  b. B: John is there, or both John and Mary. *(implied: ~~not Mary,~~ not Bill)*

This poses a challenge for traditional pragmatic accounts of exhaustivity, which are based on considerations of informational strength, i.e., the Gricean maxim of Quantity (e.g., Horn 1972; Gazdar 1979; Schulz and Van Rooij 2006; Spector 2007; Geurts 2011). The reason is that considerations of informational strength alone are arguably unable to distinguish between examples like (1a) and (1b). After all, the most straightforward semantic informational contents (i.e., literal sentence meanings) and hence primary informational intents (i.e., speaker meanings) for (1a) and (1b) would correspond to the classical meanings of their closest translations into predicate logic, Pj and $Pj \vee (Pj \wedge Pm)$ – but these are classically (informationally) equivalent. I will call this the **granularity problem**: the traditional, information-based pragmatic approach is too coarse-grained to see the difference between (1a) and (1b).

The granularity problem was noted already by Gazdar (1979), and several approaches have been explored. Gazdar tried to solve it by assuming that utterances have “clausal” implications, to the effect that a speaker should be uncertain about any embedded clause of an uttered

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sentence, e.g., the disjuncts of a disjunction. However, besides overgenerating clausal implications, the pragmatic explanation for clausal implications relies on the assumption that both embedded clauses and their negations are always relevant, a type of symmetry that is not plausible (Horn, 1989) and that leads to the well-known symmetry problem (Kroch, 1972). More recent approaches can be divided into two main branches:

- **Localist:** exhaustivity operators are applied to each disjunct (e.g., Chierchia et al. 2012), potentially motivated pragmatically by considerations of redundancy (e.g., Katzir and Singh 2013; Ciardelli and Roelofsen 2016).
- **Globalist:** an exhaustivity operator is applied only globally, to the disjunction as a whole, but the operator is a more sophisticated one that somehow has access to the individual disjuncts (Schulz and Van Rooij 2006; Alonso-Ovalle 2008). No pragmatic motivation for these operators has been given.

The current paper aims to mend the gap in the globalist approaches, by outlining a pragmatic motivation for an adequate exhaustivity operator. To that end I adopt the theory of Attentional Pragmatics (Westera 2017), which defines a set of maxims that govern not only information sharing, but also attention sharing – a promising approach because while (1a) and (1b) are informationally equivalent, they are arguably attentionally distinct.

The theory of Attentional Pragmatics is summarized in section 2; section 3 derives a new exhaustivity operator from this theory; and section 4 demonstrates its (partial) conservativeness with regard to existing operators. Section 5 concludes.

2. Attentional Pragmatics (summary of Westera 2017)

2.1. Framework and formalism

For a clear exposition it is necessary that I summarize the conceptual and formal pragmatic framework adopted in Westera 2017. A core assumption is the following:

> **Assumption 1.** Speakers have certain communicative intentions, e.g., to share a piece of information, the objects of which are called "intents".

Intents are to be distinguished from the (semantic) *contents* of a sentence. This distinction is adopted from Bach and Harnish 1979, and it generalizes Grice's (1989) distinction between *speaker meaning* and *sentence meaning*. In this paper I will say only very little about semantic contents; I will just presuppose that an adequate semantics exists which, through the maxim of Manner, delivers the assumed intents. Another core assumption is the following:

> **Assumption 2.** A goal of making a certain piece of information common ground is not pursued on its own, but as part of what is called a "theme": a set of propositions that share a certain subject matter and that each ought to be made common ground.

Themes are more commonly called "questions under discussion", but this gives rise to a potentially harmful confusion between questions as discourse goals, as utterances, as meanings of interrogative sentences and as meanings of embedded interrogative-like constructions.

The assumed intents and themes for the relevant examples, as well as the conversational maxims, will be specified in *Intensional Logic* (Montague, 1973), albeit with doxastic rather than alethic modality and with some additional notation conventions. I refer to the exposition in Gamut 1991 (vol.2) for the basic formalism. As a brief reminder: the operators $^\wedge$ and $^\vee$ signify abstraction over and application to worlds, which will be used in this paper almost exclusively to switch between propositions and their truth values, i.e., $^\wedge\varphi$ can generally be read as "(the proposition) that φ", and $^\vee p$ as "the proposition p is true here". To illustrate, the formula $\Box(Pj \wedge \mathcal{T}_0(^\wedge Pj))$ might express that the speaker takes herself to know that John is at the party and that the proposition that John is at the party is an element of the main theme.

As is common, expressions of certain relevant types will be distinguished typographically. Besides using lowercase for individual constants/variables ($a,b,c,\ldots$ of type e) and uppercase for predicates ($A,B,C,\ldots$ of type $\langle e,t\rangle$), I will use lowercase calligraphic constants/variables for propositions ($\mathcal{a},\mathcal{b},\mathcal{c},\ldots$ of type $\langle s,t\rangle$) and uppercase calligraphic for sets of propositions ($\mathcal{A},\mathcal{B},\mathcal{C},\ldots$ of type $\langle\langle s,t\rangle,t\rangle$). Furthermore, as a notational convention, for all unary, first-order predicate constants P, I may write, e.g., $Pjmb$ to mean $Pj \wedge Pm \wedge Pb$. In addition, it will occasionally be convenient to conceive of functions of type $\langle a,t\rangle$ as sets of things of type a, and to use the usual set-theoretical operations and relations within the object language (these can be defined as mere notational shorthands; Zimmermann 1989). Lastly, for any set-type expression X I will write $X^\cap$ to mean the closure of X under intersection.

In order to formalize the theory, type-theoretical expressions will be interpreted on a subclass of *admissible models*, designed so as to interpret certain constants in a certain way, e.g., the constant I-RELATION will be interpreted basically as the Gricean maxim of I(nformational)-Relation (cf. Montague's meaning postulates). Admissible models must also validate the KD45 belief axioms, plus *intent introspection* and *theme introspection*, which ensure that the speaker knows the interpretations of constants denoting intents and themes of the utterance (e.g., $\mathcal{p}_0$ for the main informational intent, i.e., what is asserted) – I leave their definitions implicit. Thus:

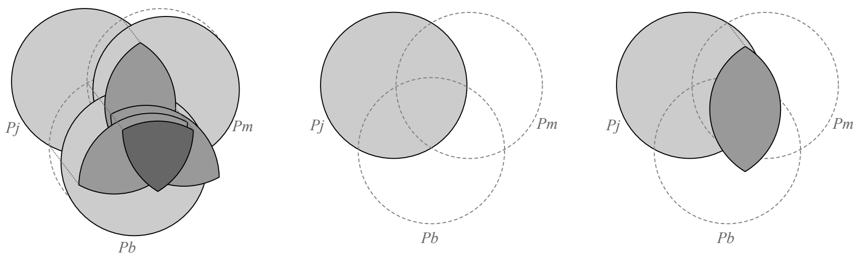
Definition 1 (Admissible model)**.** A model $\mathbf{M}$ (or $\langle \mathbf{M}, w_0\rangle$) is an *admissible model* iff:

1. $\mathbf{M}$ validates (makes true in all its worlds) the KD45 belief axioms;
2. $\mathbf{M}$ validates intent and theme introspection; and
3. $\mathbf{M}$ validates the definitions of the maxims, to be given below.

And it is an admissible model *for a given example* if, and only if, in addition:

4. w_0 validates all formal statements given in the example (in a gray box); and
5. W is sufficiently large, that is, every contingent first-order formula that can be constructed from only constants used in the example, variables, connectives and quantifiers, is true in some $w \in W$.

Admissible models for a given example enable us to instantly formalize the relevant parts of a



(a) (b) (c)

Figure 1: The theme and attentional intents of (2a), (2b) and (2c).

given example and prove potentially interesting things about it, e.g., that an utterance complies with the Gricean maxim of Relation, which is the case if in all admissible models for the example the constant I-RELATION returns true in the actual world, when applied to the relevant intents and themes, and given the beliefs and goals of the speaker.

On top of the common assumption that utterances have themes and intents, we need a particular type of intent to solve the granularity problem (building on Ciardelli et al. 2009):

Assumption 3. Utterances have *attentional intents*. An attentional intent is a non-empty set of propositions to which a speaker intends to draw the audience's attention.

Note that an utterance may draw attention to many things, propositions and otherwise, including (but not limited to) everything explicitly mentioned in the utterance – but not everything will be part of what the speaker *intended* to draw attention to, i.e., part of the attentional intent. Note furthermore that the assumption that utterances have attentional *intents* does not commit one to the assumption of a corresponding dimension of attentional semantic *content*. In Westera 2017 it is shown that attentional intents can typically be clearly conveyed without such an enriched semantic dimension, simply on the basis of the informational contents of all uttered constituents.

To illustrate, and also to get acquainted with the formalism, let us consider the intents and themes of (1) with which this chapter started, repeated here as (2):

(2) a. A: Who (of John, Mary and Bill) is at the party?

$\mathcal{T}_0 = \{{}^\wedge Pj, {}^\wedge Pm, {}^\wedge Pb\}^\cap \qquad \mathcal{A}_0 = \{{}^\wedge Pj, {}^\wedge Pm, {}^\wedge Pb\}^\cap$

b. B: John is at the party.

$\mathcal{T}_0 = \{{}^\wedge Pj, {}^\wedge Pm, {}^\wedge Pb\}^\cap \qquad p_0 = {}^\wedge Pj \qquad \mathcal{A}_0 = \{{}^\wedge Pj\}$

c. B: John is at the party, or John and Mary.

$\mathcal{T}_0 = \{{}^\wedge Pj, {}^\wedge Pm, {}^\wedge Pb\}^\cap \qquad p_0 = {}^\wedge Pj \qquad \mathcal{A}_0 = \{{}^\wedge Pj, {}^\wedge Pjm\}$

For each utterance $\mathcal{T}_0$ denotes the main theme, p_0 the main informational intent (what is asserted) and $\mathcal{A}_0$ the main attentional intent. Recall that $\{...\}^{\cap}$ is a notational shorthand for closure under intersection. For independent motivation of the assumed themes and intents I refer to Westera 2017. The assumed attentional intents of (2a), (2b) and (2c) are depicted, from left to right, in figure 1. This type of pictorial representation will be relied upon again further below. In it, each attentional intent is depicted as a Venn diagram on the set of all possible worlds, based on the three atomic propositions of John's, Mary's, and Bill's presence (the circles). Overlapping propositions in the attentional intent – the gray regions – are pulled apart in a third dimension, towards the reader as it were, for clearer presentation.

2.2. Maxims governing informational intents

Recall that the maxims are defined by fixing the interpretation of a number of designated constants in the class of admissible models. The *I(nformation)-maxims* closely resemble Grice's (1989, ch.2) maxims (except Manner, which will not play an explicit role in this paper). Grice's informal approach can of course be formalized in different ways, and for a motivation of the following definition I refer to Westera 2017 (e.g., it predicts the right distribution of intonational cues of maxim violations; cf. Westera 2013):

Definition 2.

1. $\text{I-Q\scriptsize{UALITY}}(p) = \Box^{\vee} p$
   "Intend to share only information you take to be true."

2. $\text{I-R\scriptsize{ELATION}}(p, \mathcal{T}) = \mathcal{T}(p)$
   "Intend to share only information that is thematic."

3. $\text{I-Q\scriptsize{UANTITY}}(p, \mathcal{T}) = \forall q \left(\begin{pmatrix} \text{I-Q\scriptsize{UALITY}}(q) \wedge \\ \text{I-R\scriptsize{ELATION}}(q, \mathcal{T}) \end{pmatrix} \rightarrow (p \subseteq q) \right)$
   "Intend to share all thematic information you take to be true."

From this definition we can derive some general results, e.g., that a speaker will always know whether a given intent complies with the I-maxims or not, and that if there exists a compliant intent then it is the only one. We can also compute more concrete predictions, e.g.:

Fact 1. For all admissible models $\langle \mathbf{M}, w_0 \rangle$ for example (2b):

$$\mathbf{M}, w_0 \models \text{I-Q\scriptsize{UANTITY}}(p_0, \mathcal{T}_0) \rightarrow (\neg\Box Pm \wedge \neg\Box Pb)$$

This I-Quantity implication is the starting point of traditional pragmatic accounts of exhaustivity implications. However, since it is (correctly) predicted for (2b) and (2c) alike, it does not provide us with a handle for distinguishing them – this is the granularity problem. Note, furthermore, that the absence of belief ($\neg\Box Pm$) does not entail a belief to the contrary ($\Box\neg Pm$), i.e., exhaustivity. This is the well-known *epistemic step*, which elsewhere I have argued is a genuine empirical problem for the standard, I-Quantity-based recipe for exhaustivity (Westera 2014).

2.3. Maxims governing attentional intents

The *A(ttention)-maxims* follow the same general recipe as the I-maxims, except for the addition of the maxim of A-Parsimony, which I will briefly motivate shortly:

Definition 3.

1. $\text{A-Q}\textsc{uality}(\mathcal{A}) = \forall a(\mathcal{A}(a) \rightarrow \Diamond {}^{\vee}a)$
   "Intend to draw attention only to propositions that you consider possible."

2. $\text{A-R}\textsc{elation}(\mathcal{A},\mathcal{T}) = \forall a(\mathcal{A}(a) \rightarrow \mathcal{T}(a))$
   "Intend to draw attention only to thematic propositions."

3. $\text{A-P}\textsc{arsimony}(\mathcal{A},\mathcal{T}) = \forall a \left(\begin{array}{c} (\mathcal{A}(a) \wedge \text{A-Q}\textsc{uality}(\{a\})) \rightarrow \\ \Diamond \left({}^{\vee}a \wedge \forall b \left(\left(\begin{array}{c} b \subset a \wedge \\ \text{A-R}\textsc{elation}(\{b\},\mathcal{T}) \end{array} \right) \rightarrow \neg {}^{\vee}b \right) \right) \end{array} \right)$
   "Intend to draw attention to a proposition only if, if you consider it possible, you consider it possible independently of any more specific thematic proposition(s)."

4. $\text{A-Q}\textsc{uantity}(\mathcal{A},\mathcal{T}) = \forall a \left(\left(\begin{array}{c} \text{A-Q}\textsc{uality}(\{a\}) \wedge \\ \text{A-R}\textsc{elation}(\{a\},\mathcal{T}) \wedge \\ \text{A-P}\textsc{arsimony}(\{a\},\mathcal{T}) \end{array} \right) \rightarrow \mathcal{A}(a) \right)$
   "Intend to draw attention to all thematic propositions you consider independently possible."

Again some general results can be proven, e.g., that a speaker will always know whether the A-maxims are complied with, and that if there is a compliant attentional intent then it is the only one. As on the informational side, for a motivation of this particular definition of the maxims I refer to Westera 2017. I will here summarize only the motivation for A-Parsimony. Consider a speaker B who believes that if John and Mary are at the party, then so is Bill (i.e., $\Box(Pjm \rightarrow Pb)$). Now, consider the following two utterances made by this speaker:

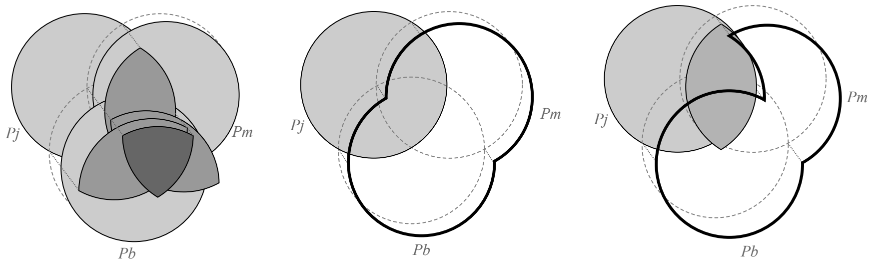
(3) a. B: John is at the party, or John, Mary and Bill.

$\Box(Pjm \rightarrow Pb)$
$\mathcal{T}_0 = \{{}^{\wedge}Pj, {}^{\wedge}Pm, {}^{\wedge}Pb\}^{\cap}$ $\quad \mathcal{A}_0 = \{{}^{\wedge}Pj, {}^{\wedge}Pjmb\}$ $\quad p_0 = {}^{\wedge}Pj$

b. (?) B: John is there, or John and Mary, or John, Mary and Bill.

$\Box(Pjm \rightarrow Pb)$
$\mathcal{T}_0 = \{{}^{\wedge}Pj, {}^{\wedge}Pm, {}^{\wedge}Pb\}^{\cap}$ $\quad \mathcal{A}_0 = \{{}^{\wedge}Pj, {}^{\wedge}Pjm, {}^{\wedge}Pjmb\}$ $\quad p_0 = {}^{\wedge}Pj$

I take it that the utterance in (3b) is intuitively quite strange: why, given B's beliefs, did B include the middle disjunct – or, in terms of attentional intents, why did B intend to draw attention to John and Mary's joint presence (${}^{\wedge}Pjm$)? The maxim of A-Parsimony predicts precisely this strangeness: drawing attention to John and Mary's joint presence is not parsimonious, i.e., superfluous, because B does not consider it possible independently of the presence of all three of them (${}^{\wedge}Pjmb$). More precisely, it can be proven for (3b) that the attentional intent violates



(a) (b) (c)

Figure 2: The theme, attentional intents and and exhaustivity implications of (2b) and (2c).

either A-Quality, if $^\wedge Pjmb$ is not in fact considered possible, or A-Parsimony, if it is and $^\wedge Pjm$ is not possible independently of it. In contrast, for (3a) there does exist an admissible model in which all the maxims are complied with.

3. Deriving an exhaustivity operator

I will first apply the maxims to some concrete examples, before presenting a general result and a derivative exhaustivity operator. Consider once again the contrast with which this chapter started, with the assumed themes and intents as given in (2), repeated here:

(2) a. A: Who (of John, Mary and Bill) is at the party?

$\mathcal{T}_0 = \{^\wedge Pj, ^\wedge Pm, ^\wedge Pb\}^\cap \qquad \mathcal{A}_0 = \{^\wedge Pj, ^\wedge Pm, ^\wedge Pb\}^\cap$

b. B: John is at the party.

$\mathcal{T}_0 = \{^\wedge Pj, ^\wedge Pm, ^\wedge Pb\}^\cap \qquad p_0 = {}^\wedge Pj \qquad \mathcal{A}_0 = \{^\wedge Pj\}$

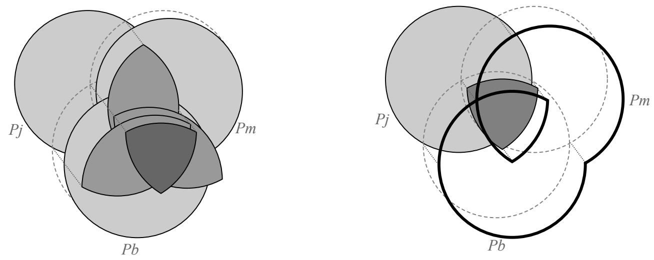
c. B: John is at the party, or John and Mary.

$\mathcal{T}_0 = \{^\wedge Pj, ^\wedge Pm, ^\wedge Pb\}^\cap \qquad p_0 = {}^\wedge Pj \qquad \mathcal{A}_0 = \{^\wedge Pj, ^\wedge Pjm\}$

The exhaustivity implication we wish to derive for (2b) is that B believes that Mary and Bill are not at the party ($\Box\neg Pm$, $\Box\neg Pb$). For (2c) we want to derive the same for Bill ($\Box\neg Pb$), but not for Mary – with regard to Mary we may want to derive merely that the speaker does not consider Mary's presence possible independently of John's ($\Box(Pm \rightarrow Pj)$). The desired implications are depicted schematically in figure 2, which is identical to figure 1 given earlier except for the bold outlines, which contain those worlds that the exhaustivity implications would exclude from the speaker's doxastic state. Formally, exhaustivity follows from the assumption that B takes her attentional intent to comply with A-Quantity ($\Box\,$A-$\textsc{Quantity}(\mathcal{A}_0, \mathcal{T}_0)$). That is, for (2b), as depicted in figure 2(b), we get:

Fact 2. For all admissible models $\langle \mathbf{M}, w_0 \rangle$ for (2b):

$$\mathbf{M}, w_0 \models \Box\,\text{A-}\textsc{Quantity}(\mathcal{A}_0, \mathcal{T}_0) \rightarrow (\Box\neg Pb \wedge \Box\neg Pm)$$



(a) (b)

Figure 3: The theme, attentional intent and exhaustivity implication of example (4).

And for (2c), as depicted in figure 2(c), we get:

Fact 3. For all admissible models $\langle \mathbf{M}, w_0 \rangle$ for (2c):

$$\mathbf{M}, w_0 \models \Box\,\text{A-Q}\textsc{uantity}(\mathcal{A}_0, \mathcal{T}_0) \rightarrow (\Box\neg Pb \wedge \Box(Pm \rightarrow Pjm))$$

And there exists such a model where:

$$\mathbf{M}, w_0 \not\models \Box\,\text{A-Q}\textsc{uantity}(\mathcal{A}_0, \mathcal{T}_0) \rightarrow \Box\neg Pm$$

Instead, for all admissible models for (2c) we have:

$$\mathbf{M}, w_0 \models \Box\,\text{A-Q}\textsc{uality}(\mathcal{A}_0) \rightarrow \neg\Box\neg Pm$$

Here the implication that Mary's presence is not possible independently of John's ($\Box(Pm \rightarrow Pjm)$) derives from A-Quantity's conditioning on A-Parsimony: B didn't draw attention to Mary's presence, so she must not consider it possible independently of John and Mary's joint presence. But note that, in this case, the same can be inferred from I-Quality: believing that John is at the party ($\Box Pj$) entails believing that he is if Mary is ($\Box(Pm \rightarrow Pjm)$). Thus, for (2c) A-Parsimony is not strictly necessary. But it does make a difference for the variant in (3a) given earlier, repeated here in (4) (though without the particular beliefs):

(4) B: John is at the party, or John, Mary and Bill.

$\mathcal{T}_0 = \{{}^\wedge Pj, {}^\wedge Pm, {}^\wedge Pb\}^\cap$ $\quad p_0 = {}^\wedge Pj$ $\quad \mathcal{A}_0 = \{{}^\wedge Pj, {}^\wedge Pjmb\}$

Figure 3(a) and (b) depict the assumed theme and the attentional intent, in which the bold outline again contains those worlds excluded by the exhaustivity implication from B's doxastic state. The implication is that, according to B, Mary or Bill can be at the party only if everyone is. Unlike before, this implication follows from A-Quantity and not from I-Quality (since $\Box^\vee Pj$ does not entail $\Box(Pm \rightarrow Pjmb)$). Hence, A-Parsimony does occasionally make a difference.

To derive a more general result, let us restrict our attention to cases where the theme has the property of *chain completeness*, which means that for every chain of ever more specific, thematic propositions, their infinitary intersection is also thematic. The role of this restriction is clarified in the proof in the appendix. The following result obtains:

Fact 4. For all admissible models **M**, for arbitrary constants $\mathcal{A}_i$ and $\mathcal{T}_j$, where the theme denoted by $\mathcal{T}_j$ is chain-complete:

$$\begin{aligned}\mathbf{M} \models \ & \Box\text{A-QUANTITY}(\mathcal{A}_i, \mathcal{T}_j) \rightarrow \\ & \forall a \begin{pmatrix} (\mathcal{T}_j(a) \wedge \neg \mathcal{A}_i(a)) \rightarrow \\ \qquad \Box(\neg {}^{\vee}a \vee \exists b(\mathcal{A}_i(b) \wedge (b \subset a) \wedge {}^{\vee}b)) \end{pmatrix}\end{aligned}$$

And if in **M** the speaker's beliefs are accurate (factivity), then:

$$\begin{aligned}\mathbf{M} \models \ & \Box\text{A-QUANTITY}(\mathcal{A}_i, \mathcal{T}_j) \rightarrow \\ & \forall a \begin{pmatrix} (\mathcal{T}_j(a) \wedge \neg \mathcal{A}_i(a)) \rightarrow \\ \qquad (\neg {}^{\vee}a \vee \exists b(\mathcal{A}_i(b) \wedge (b \subset a) \wedge {}^{\vee}b)) \end{pmatrix}\end{aligned}$$

In words: compliance with A-Quantity implies that, for every proposition that is thematic and to which no attention is intended to be drawn, the speaker must think that it does not obtain or that, if it does obtain, a more specific proposition obtains to which attention is intended to be drawn.

We can define a notational shorthand for the second result of fact 4, namely by taking its intension ($^\wedge$), while making sure through abstraction and application that the intent and theme constants are interpreted in the initial world of evaluation. We then get:

Definition 4. For $\mathcal{A}$ and $\mathcal{T}$ any constant or variable of type $\langle\langle s,t\rangle,t\rangle$, let the following notational shorthand be defined:

$$\text{EXH}(\mathcal{A}, \mathcal{T}) \stackrel{\text{def}}{=} \lambda \mathcal{T}' \left(\lambda \mathcal{A}'\ {}^{\wedge}\forall a \begin{pmatrix} (\mathcal{T}'(a) \wedge \neg \mathcal{A}'(a)) \rightarrow \\ \qquad (\neg {}^{\vee}a \vee \exists b(\mathcal{A}'(b) \wedge (b \subset a) \wedge {}^{\vee}b)) \end{pmatrix} (\mathcal{A}) \right) (\mathcal{T})$$

Note that this exhaustivity operator is not a substantive assumption of the theory, but a mere notational shorthand for the exhaustivity implications that are predicted by the theory anyway, at least in admissible models, given factivity and compliance with A-Quantity. The operator can also be formulated in the metalanguage, in a more set-theoretical fashion (parameters $\mathbf{M}, w, g$ for the interpretation function $[.]$, omitted for readability, are the same throughout):

Fact 5. For arbitrary constants or variables $\mathcal{A}$ and $\mathcal{T}$:

$$[\text{EXH}(\mathcal{A}, \mathcal{T})] = \bigcap_{\substack{a \in [\mathcal{T}] \\ a \notin [\mathcal{A}]}} (\overline{a} \cup \bigcup_{\substack{b \in [\mathcal{A}] \\ b \subset a}} b)$$

This obtains fairly directly, and I will omit a formal proof: the universal quantifier in definition 4 corresponds here to generalized intersection; negation to complementation, disjunction to union and existential quantification to generalized union. To illustrate, notice that the complements of the bold outlines in figures 2 and 3 given earlier correspond precisely to the sets of worlds characterized by the exhaustivity operator, when applied to the relevant themes and intents.

(a) (b)

Figure 4: The theme and attentional intent (with exhaustivity implication) of (5B).

To illustrate the operator, let us consider a slightly more elaborate example:

(5) A: How many kids does John have?

B: John has one, three, or five kids.

$\mathcal{T}_0 = \{{}^\wedge K0, {}^\wedge K1, {}^\wedge K2, {}^\wedge K3, {}^\wedge K4, \ldots\} \qquad \mathcal{A}_0 = \{{}^\wedge K1, {}^\wedge K3, {}^\wedge K5\}$
$p_0 = {}^\wedge K1 \quad$ (equivalent to ${}^\wedge(K1 \vee K3 \vee K5)$)

I assume an "at least"-interpretation of numerals for the sake of illustration (the structure of interest can be replicated without numerals). The theme and the attentional intent of (5B) are depicted in figure 4. The striped regions together contain the worlds that are excluded by the operator (like the bold outlines before). The outcome of the operator can be computed as follows, now writing bare numerals n as a shorthand for ${}^\wedge Kn$:

$$\begin{array}{rl} \text{E}\textsc{xh}(\mathcal{A}_0, \mathcal{T}_0) & = (\overline{0} \cup 1 \cup 3 \cup 5) \quad \cap \quad (\overline{2} \cup 3 \cup 5) \quad \cap \quad (\overline{4} \cup 5) \quad \cap \overline{6} \cap \overline{7} \cap \ldots \\ & = \quad 1 \quad \cap \quad (\overline{2} \cup 3) \quad \cap \quad (\overline{4} \cup 5) \quad \cap \overline{6} \\ & = (1 \cap \overline{2} \cap \overline{4} \cap \overline{6}) \cup \ldots \cup (1 \cap 3 \cap \overline{4} \cap \overline{6}) \cup \ldots \cup (1 \cap 3 \cap 5 \cap \overline{6}) \\ & = \quad (1 \cap \overline{2}) \quad \cup \quad (3 \cap \overline{4}) \quad \cup \quad (5 \cap \overline{6}) \end{array}$$

The last line says that John has exactly one, exactly three, or exactly five kids.

4. (Partial) conservativeness with regard to existing operators

The current exhaustivity operator is motivated pragmatically. In contrast, existing operators tend to have been motivated either only descriptively (Groenendijk and Stokhof, 1984; Alonso-Ovalle, 2008) or, in part, in terms of I-Quantity (as in Schulz and Van Rooij 2006; Spector 2007); and sometimes they are conceived of as grammatical devices (e.g., Fox, 2007; Chierchia et al., 2012; Katzir and Singh, 2013). Different motivations may justify different applications of the operator, and hence lead to different empirical predictions even if the operators would be equivalent when regarded purely as abstract mathematical objects. Nevertheless, let us compare the current operator to previous ones at this abstract, mathematical level. I will consider three operators:

1. the *minimal worlds* operator $\text{E}\textsc{xh}_{\text{mw}}$ discussed in Spector 2016 (attributed to Spector 2007 and Schulz and Van Rooij 2006);
2. the *innocent exclusion* operator $\text{E}\textsc{xh}_{\text{ie}}$ from Alonso-Ovalle 2008 (based on the notion of innocent exclusion from Fox 2007); and
3. the *dynamic* operator $\text{E}\textsc{xh}_{\text{dyn}}$ from Schulz and Van Rooij 2006.

I will also discuss the grammatical approach, which applies an operator like $\textsc{Exh}_{\text{mw}}$ to each disjunct separately. Correspondences between these operators and the current one will be stated only for cases in which (i) application of the current operator is warranted, and (ii) the other operator was intended to apply. Condition (i) is satisfied in *operable models*:

Definition 5 (Operable model)**.** An admissible model $\langle \mathbf{M}, w_0 \rangle$ is *operable* if and only if the speaker's beliefs are accurate (factivity), in w_0 the relevant intents comply with the maxims relative to the relevant themes, and the set of thematic propositions in w_0 is chain-complete.

Although I will state (partial) correspondences to each of the aforementioned operators, for reasons of space a proof will be given (in the appendix) only for the third.

First, the **minimal worlds** operator (Schulz and Van Rooij, 2006; Spector, 2007, 2016) can be defined in the current framework by temporarily adding $\textsc{Exh}_{\text{mw}}$ to the language, with the following semantics (as before, the omitted parameters of $[\![.]\!]$ are the same everywhere):

Definition 6. For arbitrary constants/variables p and $\mathcal{T}$, let:

$$[\![\textsc{Exh}_{\text{mw}}(p,\mathcal{T})]\!] \overset{\text{def}}{=} \{w \in [\![p]\!] \mid \text{there is no } w' \in [\![p]\!] \text{ such that: } \{a \mid a \in [\![\mathcal{T}]\!], w' \in a\} \subset \{a \mid a \in [\![\mathcal{T}]\!], w \in a\}\}$$

That is, the proposition denoted by p must be true in the relevant worlds w, together with a set of other thematic propositions that is *minimal* compared to the sets of true thematic propositions in other worlds w' in which the proposition denoted by p is true. The minimal worlds operator aligns with the current operator if the attentional intent is a singleton set:

Fact 6. Take any utterance with intents denoted by p_i and $\mathcal{A}_j$ such that $\mathcal{A}_j = \{p_i\}$ is true, and theme denoted by $\mathcal{T}_k$. For any admissible, operable model $\langle \mathbf{M}, w_0 \rangle$ for such an utterance:

$$\mathbf{M}, w_0 \models \textsc{Exh}_{\text{mw}}(p_i, \mathcal{T}_k) = p_i \cap \textsc{Exh}(\mathcal{A}_j, \mathcal{T}_k)$$

This result shows that the operators align when attention does not really make a difference. I refer to Spector 2016 for a detailed comparison of the operator $\textsc{Exh}_{\text{mw}}$ to other existing operators from Krifka 1993 and Fox 2007. None of these operators can distinguish between (1a) and (1b) with which this chapter started – this is the granularity problem.

Second, the **innocent exclusion** operator of Alonso-Ovalle (2008) is formulated in terms of *Alternative Semantics*, but it can be readily applied to attentional intents. It relies on a set IE of *innocently excludable* propositions, a notion adopted from Fox 2007:

Definition 7. For A a set of propositions, and $A^{\cap}$ its closure under intersection, let:

$$\text{IE}(A) \overset{\text{def}}{=} \{a \in A^{\cap} \mid \text{for all } b \in A, \text{ any way of excluding from } b \text{ as many } a' \in A^{\cap} \text{ as consistency allows, excludes also } a\}$$

In terms of innocent exclusion, the operator is defined as follows:

Definition 8. For an arbitrary constant/variable $\mathcal{A}$:

$$[\text{EXH}_{\text{ie}}(\mathcal{A})] \overset{\text{def}}{=} \bigcup[\mathcal{A}] \cap \bigcap_{a \in \text{IE}([\mathcal{A}])} \overline{a}$$

This operator aligns with the current one with regard to (1a) and (1b) (i.e., (2b,c)). However, for the variant "John, or John, Mary and Bill" in (4) it fails to predict exhaustivity. One problem is that Alonso-Ovalle does not derive the theme from some preceding question, but computes it from the utterance itself by taking the set of disjuncts and closing this set under intersection. A more serious problem is that his operator never excludes *part* of a proposition, like in (4) the part of the proposition denoted by $^\wedge Pjm$ that is not contained in the proposition denoted by $^\wedge Pjmb$ – after all, a proposition is not "innocently excludable" if it contains a proposition that isn't. Still, for a restricted set of cases our operators are formally equivalent:

Fact 7. Take any utterance with intents denoted by p_i and $\mathcal{A}_j$ and theme denoted by $\mathcal{T}_k$ s.t.:

- $p_i = \bigcup \mathcal{A}_j$;
- $\mathcal{T}_k = \mathcal{A}_j^{\cap}$; and
- $\forall a((\mathcal{T}_k(a) \wedge \neg \mathcal{A}_j(a)) \rightarrow \neg \exists b(b \subset a \wedge \mathcal{A}_j(b)))$.

For any admissible, operable model $\langle \mathbf{M}, w_0 \rangle$ for such an utterance:

$$\mathbf{M}, w_0 \models \text{EXH}_{\text{ie}}(\mathcal{A}_j) = (p_i \cap \text{EXH}(\mathcal{A}_j, \mathcal{T}_k))$$

The third bullet excludes cases like (4), where mere parts of propositions need to be excluded.

Third, the **dynamic** operator EXH_{dyn} of Schulz and Van Rooij 2006 is in a way a modification of the "minimal worlds" operator EXH_{mw}, the difference being that EXH_{dyn} does not minimize the set of true thematic propositions among *all* worlds in the informational intent, but only within certain subsets. I will bypass the details of how they determine these subsets, a matter for which they use *dynamic semantics* – in a nutshell, they compare only world-assignment pairs that share the same assignment (discourse referents). At least for disjunctive utterances, which they assume introduce a discourse referent for each disjunct, this amounts simply to comparing only worlds within some proposition in the attentional intent. Hence, for present purposes their operator can be (re)defined as follows:

Definition 9. For arbitrary constants/variables $\mathcal{A}$, and $\mathcal{T}$, let:

$$[\text{EXH}_{\text{dyn}}(\mathcal{A}, \mathcal{T})] = \{w \mid \text{for some } a \in [\mathcal{A}]\text{: } w \in a \text{ and there is no } w' \in a \text{ s.t. } \{b \mid b \in [\mathcal{T}], w' \in b\} \subset \{b \mid b \in [\mathcal{T}], w \in b\}\}$$

Whether this definition corresponds exactly to theirs depends on the degree to which the current attentional intents align with what they consider to be discourse referents – a matter which I defer to Westera 2017. But as it is defined here the operator EXH_{dyn} can distinguish between (1a) and (1b), as well as account for (4) – indeed, our operators align quite generally:

Fact 8. Take any utterance with intents denoted by p_i and $\mathcal{A}_j$ and a theme denoted by $\mathcal{T}_k$, and for which the following is true:

- $p_i = \bigcup \mathcal{A}_j$; and
- $\mathcal{T}_k = \mathcal{T}_k^{\cap}$.

For any admissible, operable model $\langle \mathbf{M}, w_0 \rangle$ for such an utterance:

$$\mathbf{M}, w_0 \models \text{EXH}_{\text{dyn}}(\mathcal{A}_j, \mathcal{T}_k) = (p_i \cap \text{EXH}(\mathcal{A}_j, \mathcal{T}_k))$$

This highlights that the contribution of this paper is not the exhaustivity operator in itself but its derivation from Attentional Pragmatics. In contrast, Schulz and Van Rooij offer only a partial explanation for their operator – they do not motivate its sensitivity to discourse referents, which is precisely what gives it an edge over the other operators. The part which they do motivate (basically EXH_{mw}) relies on I-Quantity, and hence runs into the granularity problem.

Lastly, let us consider the **grammatical approach** to exhaustivity, which assumes that operators like EXH_{mw} are covertly applied to each disjunct separately. The dynamic operator EXH_{dyn}, by virtue of its definition, effectively "exhaustifies" each individual disjunct in a similar fashion. Hence, fact 8 entails a correspondence also between the current operator (as well as EXH_{dyn}) and the grammatical approach. Nevertheless, Attentional Pragmatics *doesn't* predict, unlike the grammatical approach, that individual disjuncts are interpreted exhaustively. Roughly, the difference between our approaches can be paraphrased as follows:

(6) B: John, or John, Mary and Bill.

a. **Grammatical approach:** John *and no one else* was there, or John, Mary and Bill. $(Pj \wedge \neg Pm \wedge \neg Pb) \vee Pjmb)$

b. **Attentional Pragmatics:** John was there, or John, Mary and Bill – *and if Mary or Bill was there then everyone was.* $((Pj \vee Pjmb) \wedge ((Pm \vee Pb) \rightarrow Pjmb))$

Although the two paraphrases (and formulae) are classically, informationally equivalent, only (6a) involves the exhaustive interpretation of an individual disjunct. What this shows is that some at first sight "local" exhaustivity effects can be predicted by a globalist pragmatic theory – of course provided it is sensitive to some dimension of speaker meaning that, while global, reflects the syntactic structure of the uttered sentence more closely than informational intents do (cf. Simons 2011). This doesn't mean that Attentional Pragmatics can account for *all* purportedly local exhaustivity effects – such effects may well be a mixed bag (Geurts, 2011). Nor does a formal correspondence mean that Attentional Pragmatics and the grammatical approach make the same predictions – this depends, after all, on where and when the grammatical approach predicts that operators be inserted, and what their sets of formal alternatives are.

Several proponents of the grammatical approach have proposed that local exhaustification is driven by considerations of redundancy (e.g., Katzir and Singh 2013; essentially following Hurford 1974). They note that, in cases like (6), the stronger disjunct does not contribute to the information conveyed by the utterance *unless* the weaker disjunct is interpreted exhaustively. However, as Ciardelli and Roelofsen (2016) demonstrate, this explanation may fail when one's semantics/pragmatics is more fine-grained than the traditional, information-only picture: for instance, constituents that are informationally redundant can still make an attentional difference. Indeed, according to Attentional Pragmatics the second disjunct in (6) isn't redundant, and as a consequence this theory is incompatible with redundancy-based accounts of local exhaustification in such disjunctions. Note that this doesn't mean that redundancy has no role to play in pragmatics. For one, informational redundancy may still play a role in *con*junctions where one conjunct entails the other (because from I-Quality and A-Parsimony it follows that the attentional intent may rationally contain only the conjunction as a whole). Moreover, the maxim of A-Parsimony essentially bans an *attentional* kind of redundancy.

5. Discussion

According to Attentional Pragmatics, exhaustivity implications arise not from the assumption that a rational speaker asserts all thematic propositions believed to be true, nor from local exhaustification driven by considerations of redundancy, but from the assumption that a rational speaker draws attention to all thematic propositions believed to be possible. This new perspective provides a globalist pragmatic solution to the granularity problem, one which the current paper captured in an operator. It also solves several other problems for the standard, information-based approach; I refer to Westera 2017 for an application to the occurrence of exhaustivity in cases where I-Quantity does not apply (hints, questions) and cases where the opinionatedness assumption is explicitly denied, as well as a solution to the symmetry problem. If valid, this attentional approach mandates a thorough revision of the literature on exhaustivity.

At a purely technical level, the current paper may seem to suggest that the required revision is rather minimal: the operator derived from Attentional Pragmatics is, as a purely formal device, in important respects conservative with regard to operators from the literature. However, the range of circumstances in which its application is pragmatically warranted is more restricted than the frequent reliance on exhaustivity operators in the literature seems to require. It excludes, for instance, the local operators that grammaticalists assume, but also certain global occurrences. For instance, Schulz and Van Rooij (2006) seek to apply their operator directly to conditional answers to unconditional questions, and to modalized answers to non-modalized questions, but these are cases for which in the current approach no "operable" admissible models exist: conditional/modal answers cannot compliantly address the theme introduced by unconditional/non-modal questions, hence we must not seek to directly apply our operator to them. These cases must be analyzed, rather, as involving a *theme shift*, to be explained by a separate "theme pragmatics" (Westera, 2017), i.e., a theory of how conversational goals are prioritized and organized into themes. The current maxims, in contrast, constrain only which intentions are rational *given* a theme, i.e., a set of goals.

More generally, the restrictions on the current operator's applicability reflect that it abbreviates only a rather small part of a pragmatic theory. The operator of Schulz and Van Rooij seems more ambitious; they motivate it by stating that "none of these [previously proposed] theories gives a satisfying explanation for why the scope of exhaustive interpretation should be restricted to those cases that they can actually handle" (p.8). But the converse is true as well: none of these existing theories, including Schulz and Van Rooij's, gives a satisfying explanation for why the cases that their operators appear to handle are cases that they *should* handle. If all you have is a hammer, everything looks like a nail (e.g., Maslow, 1966). By acknowledging the limited applicability of the current exhaustivity operator, and the unknown applicability of existing ones, we may begin to see subtle differences between different types of exhaustivity-like inferences, and between the types of conversational goals that are normally served by conditional and unconditional answers or plain and modalized answers.

Appendix. Proofs of facts 4 and 8

Proof of fact 4: Take an arbitrary admissible model **M** in which $\mathcal{T}_j$ complies with the chain completeness restriction. Take an arbitrary world w in this model. Suppose that the speaker takes A-Quantity to be complied with, i.e., $\mathbf{M}, w \models \Box\,\text{A-QUANTITY}(\mathcal{A}_i, \mathcal{T}_j)$. Given intent and theme introspection, this means that A-Quantity is actually complied with in w:

$$\mathbf{M}, w \models \forall a \left(\left(\begin{array}{c} \text{A-QUALITY}(\{a\}) \wedge \\ \text{A-RELATION}(\{a\}, \mathcal{T}_j) \wedge \\ \text{A-PARSIMONY}(\{a\}, \mathcal{T}_j) \end{array} \right) \rightarrow \mathcal{A}_i(a) \right) \tag{1}$$

Take an arbitrary function g that assigns to a a thematic proposition, i.e., suppose that:

$$\mathbf{M}, w, g \models \mathcal{T}_j(a) \tag{2}$$

Suppose, furthermore, that no attention is drawn to a in w:

$$\mathbf{M}, w, g \models \neg \mathcal{A}_i(a) \tag{3}$$

Since $\mathcal{A}_i(a)$ is false in w, the antecedent in (1) cannot be true either, hence at least one of its conjuncts must be false. A-Relation cannot be blamed, because the proposition denoted by a is thematic in w (from supposition (2)), so it must be either A-Quality or A-Parsimony. Let us explore the latter.

Suppose that the singleton intent denoted by $\{a\}$ does not comply with A-Parsimony in w, i.e., $\mathbf{M}, w, g \models \neg\,\text{A-PARSIMONY}(\{a\}, \mathcal{T}_0)$. This amounts to:

$$\mathbf{M}, w, g \models \Diamond^{\vee} a \wedge \Box({}^{\vee} a \rightarrow \exists b\,(b \subset a \wedge \mathcal{T}_0(b) \wedge {}^{\vee} b)) \tag{4}$$

It follows that there exists a world w' that is belief-accessible from w, such that the proposition assigned to a is true in w', and, by the second conjunct, some stronger proposition can be assigned to b that is true and thematic in w'. This means that in the original world w, the proposition assigned to b must be considered possible and, by theme introspection, thematic. Hence, we have:

$$\mathbf{M}, w, g \models \exists b (b \subset a \wedge \mathcal{T}_0(b) \wedge \Diamond^{\vee} b)$$

Since this stronger proposition b is thematic and possible, A-Quantity (which is complied with according to (1)) requires that it be an element of the attentional intent denoted by $\mathcal{A}_i$ in w, unless A-Parsimony prevents this, i.e., unless there is an even stronger thematic and possible proposition (say, c), independently of which $\mathscr{b}$ in turn is not considered possible. And so on, potentially *ad infinitum*.

To curb this potential infinitude, assume that the set of thematic propositions is *chain-complete*, i.e., that for every chain of increasingly specific thematic propositions $\mathscr{a}_0, \mathscr{a}_1, \ldots$ (i.e., such that every $\mathscr{a}_{i+1} \subset \mathscr{a}_i$), their infinitary intersection $\bigcap\{\mathscr{a}_0, \mathscr{a}_1, \ldots\}$ is also thematic. This guarantees that there exists a maximally specific thematic and possible proposition, and according to A-Quantity that must be an element of the attentional intent denoted by $\mathcal{A}_i$. This means that we can strengthen supposition (4) by adding the conjunct $\mathcal{A}_i(\mathscr{b})$, which after dropping the conjunct $\mathcal{T}_0(\mathscr{b})$ yields the following:

$$\mathbf{M}, w, g \models \Diamond^\vee \mathscr{a} \wedge \Box({}^\vee \mathscr{a} \rightarrow \exists \mathscr{b}\,(\mathscr{b} \subset \mathscr{a} \wedge \mathcal{A}_i(\mathscr{b}) \wedge {}^\vee \mathscr{b}))$$

This was derived, recall, from the supposition that the singleton intent denoted by $\{\mathscr{a}\}$ does not comply with A-Parsimony in w, i.e., that A-Parsimony is the reason why the proposition assigned to $\mathscr{a}$ is not an element of the attentional intent denoted by $\mathcal{A}_i$. The other possible reason was A-Quality, i.e., $\neg\Diamond^\vee \mathscr{a}$. Hence, we can conclude the disjunction of these two reasons:

$$\mathbf{M}, w, g \models \neg\Diamond^\vee \mathscr{a} \vee (\Diamond^\vee \mathscr{a} \wedge \Box({}^\vee \mathscr{a} \rightarrow \exists \mathscr{b}\,(\mathscr{b} \subset \mathscr{a} \wedge \mathcal{A}_i(\mathscr{b}) \wedge {}^\vee \mathscr{b})))$$

which implies: $\mathbf{M}, w, g \models \Box(\neg^\vee \mathscr{a} \vee \exists \mathscr{b}\,(\mathscr{b} \subset \mathscr{a} \wedge \mathcal{A}_i(\mathscr{b}) \wedge {}^\vee \mathscr{b}))$

By retracting suppositions (2) and (3) we obtain:

$$\mathbf{M}, w \models \forall \mathscr{a} \left(\begin{array}{l} (\mathcal{T}_j(\mathscr{a}) \wedge \neg\mathcal{A}_i(\mathscr{a})) \rightarrow \\ \qquad \Box(\neg^\vee \mathscr{a} \vee \exists \mathscr{b}(\mathcal{A}_i(\mathscr{b}) \wedge \mathscr{b} \subset \mathscr{a} \wedge {}^\vee \mathscr{b})) \end{array} \right)$$

And by retracting supposition (1), i.e., that A-Quantity is (believed to be) complied with, we obtain the first result in fact 4. The second result directly derives from this through factivity.

The restriction to chain-complete themes is only a presentational choice, that allows a simpler formulation of the main result. It is not indicative of, say, some sort of defect in the maxims. I don't think that, relative to a theme like that is not chain-complete, a speaker could rationally behave differently from what the current maxims predict, namely, to not draw attention to any particular proposition in the chain. If anything, a rational speaker may want to consider switching to a chain-complete theme instead.

Proof of fact 8: We prove the equivalence of the two operators by proving inclusion right-to-left and then left-to-right. First right-to-left: in an arbitrary admissible, operable model $\langle \mathbf{M}, w_0 \rangle$ of the specified type of utterance, take a world $w \in [p_i \cap \textsc{Exh}(\mathcal{A}_j, \mathcal{T}_k)]_{\mathbf{M},w_0,g}$. Given that $p_i = \bigcup \mathcal{A}_j$ is true in w_0, there must be some $a \in [\mathcal{A}_j]_{\mathbf{M},w_0,g}$ such that $w \in a$. Moreover, given the chain-completeness restriction on themes in operable models, and given compliance with A-Relation, there must be a most specific (strongest, smallest) proposition a of that sort. From our exhaustivity operator it follows that every thematic proposition to which no attention is drawn is either false in w, or entailed by this most specific a. Hence, w makes the proposition a true and anything entailed by it, but no other thematic propositions. Within a, then, there is no $w' \in a$ where the set of true thematic propositions is smaller than in w. Hence (by definition) $w \in [\textsc{Exh}_{\text{dyn}}(\mathcal{A}_j, \mathcal{T}_k)]_{\mathbf{M},w_0,g}$.

Conversely, take an arbitrary world $w \in [\mathrm{EXH}_{\mathrm{dyn}}(\mathcal{A}_j, \mathcal{T}_k)]_{\mathbf{M},w_0,g}$. According to the definition of $\mathrm{EXH}_{\mathrm{dyn}}$, there must be some $a \in [\mathcal{A}_j]_{\mathbf{M},w_0,g}$ such that $w \in a$ and w makes a minimal number of thematic propositions true, compared to other $w' \in a$. Given the chain-completeness restriction and compliance with A-Relation, there must be a most specific (strongest, smallest) a of that sort. Within this most specific a, any minimal set of true thematic propositions will contain a and anything entailed by it, but nothing else. (This is because, if a minimal set of true thematic propositions had contained another thematic proposition a', then the intersection $a \cap a'$ would have been thematic as well (by assumption of closure under intersection), and a would not have been possible independently of these more specific intersections, contrary to A-Parsimony, and would not have been included in the attentional intent.) Hence, this world w is contained in a, to which attention is drawn, but in no more specific thematic proposition. By definition, my operator contains all such worlds. Moreover, given that $p_i = \bigcup \mathcal{A}_j$ is true in w_0, we have that $w \in [p_i]_{\mathbf{M},w_0,g}$, and hence $w \in [p_i \cap \mathrm{EXH}(\mathcal{A}_j, \mathcal{T}_k)]_{\mathbf{M},w_0,g}$.

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Question agnosticism and change of state[1]

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Abstract. We give an account of the selectional behavior of cognitive change-of-state verbs, such as *decide*, that attempts to reduce this behavior to their change-of-state event structure. In particular, we argue that, if a cognitive verb is change-of-state, it is *Q-agnostic*—i.e. it selects both declarative and interrogative clauses. This augments previous accounts of Q-agnosticism, which have tied the distribution of declarative and interrogative clauses to semanticopragmatic notions like factivity and veridicality but which fail on nonveridical predicates like *decide*.

Keywords: lexical aspect, clause embedding, change of state, factivity, veridicality

1. Introduction

A verb's syntactic distribution is sensitive to properties of the class of events that that verb characterizes. However, not all conceivable event properties correlate with syntactic distribution. A major question in the lexical semantics literature is therefore: which event properties impact argument distribution and by what mechanisms (Gruber, 1965; Fillmore, 1970; Zwicky, 1971; Jackendoff, 1972; Grimshaw, 1979, 1990; Pesetsky, 1982, 1991; Pinker, 1989; Levin, 1993)?

For 'action verbs'—e.g. *hit* and *break*—most proposals converge on event properties such as dynamicity, telicity, change of state, and causation (see Levin and Rappaport Hovav 2005 for a review). This set differs radically from the set of properties often proposed to be relevant in determining the distribution of embedded clauses—e.g. representationality (Bolinger, 1968; Stalnaker, 1984; Farkas, 1985; Villalta, 2000, 2008; Scheffler, 2009; Anand and Hacquard, 2013), factivity (Hintikka, 1975), veridicality (Egré, 2008; Spector and Egré, 2015), and a range of other intentional (Moulton, 2009; Rawlins, 2013) and discourse-related properties (Hooper, 1975; Portner and Rubinstein, 2013; Anand and Hacquard, 2014).

In this paper, we give an account of the selectional behavior of cognitive change-of-state predicates, like *decide*. Our main claims are (i) that it is the change-of-state nature of *decide* that determines its selectional behavior and (ii) that our analysis of *decide* can be straightforwardly extended to cover a large range of what we term *Q(uestion)-agnostic* verbs—verbs which take both interrogative and declarative clauses (often termed *responsives* following Lahiri 2002).

In making this proposal, we are responding to prior approaches that attempt to reduce Q-agnosticism to properties such as factivity and veridicality (Egré 2008; cf. Hintikka 1975; Spector and Egré 2015). Verbs like *decide* are well-known counterexamples to these existing proposals, since *decide* is neither factive nor veridical in examples like (1)—decisions may be rescinded or simply not realized—yet it is Q-agnostic.

[1]We'd like to thank audiences at Sinn und Bedeutung 21, the JHU Semantics Lab, and the factivity MINSIM workshop at UMD in December 2016 as well as Valentine Hacquard and Pranav Anand for helpful discussion.

(1) Jo decided (whether) {to leave, she would leave}.

These verbs' status as counter-examples (we argue) has yet to be explained. Indeed, we suggest that the correlation between factivity/veridicality and Q-agnosticism actually obscures the fact that change-of-state is a key property for determining Q-agnosticism.

To carry this argument out, we develop a detailed account of the lexical semantics of *decide*. Our analysis is that deciding characterizes a change from a *pre-state*—which can involve either a set of alternative intentions that the agent is deciding between or a single fixed intention—to a *post-state* where some intention has been fixed on the part of the agent. Declarative complements always characterize the post-state intention, while interrogative complements characterize pre-state intentions involving multiple alternatives.

Much of the technical effort lies in deriving these facts from a core meaning for *decide* in a neo-Davidsonian event semantics with a Hacquardian (2010) approach to eventuality *content*. We suggest that this effort is worth it, since the pattern observed for *decide* generalizes to other cognitive change-of-state-verbs: interrogative clauses consistently characterize pre-state alternatives and declarative clauses consistently characterize post-state propositions.

In a wider context, our aim is to demonstrate that action verbs and clause-embedding verbs might not be so different in the properties that determine the distribution of arguments: properties like change-of-state are relevant to both. This proposal helps to reveal formal similarities between entailments that arise as a consequence of event structure and entailments related to the intentional properties of propositional attitudes. We believe these formal similarities will be useful in unifying theories that rely on event structural properties to explain syntactic distribution and those that rely on intentional properties.

We begin in Section 2 with a discussion of previous proposals that relate Q-agnosticism and veridicality. In Section 3, we apply those previous proposals to nonveridical predicates, showing some further necessary refinements to handle the particular data for *decide*. In Section 4, we present our proposal for *decide* and other change-of-state nonveridicals, as well as a compositional implementation. In Section 5, we conclude with prospects for generalizing our approach to other subclasses of Q-agnostic predicates, including epistemics and communicatives.

2. Veridicality, distribution, and interpretation

To begin, we discuss the generalizations that decision verbs are exceptions to, introducing two ways that veridicality and Q-agnosticism are believed to be related: in determining (i) the distribution of interrogatives and declaratives; and (ii) the interpretation of interrogatives.

2.1. Veridicality and embedded clause distribution

It has long been known that the distributions of interrogative and declarative embedded clauses are independent. Some clause-embedding predicates only take interrogative complements, such as *wonder* (2a); some predicates only take declarative complements, such as *believe* (2b); and some predicates take both interrogative and declarative complements, such as *know* (2c).

(2) a. Jo didn't wonder {*that, whether} Bo was smart. *Q-accepting*
b. Jo didn't believe {that, *whether} Bo was smart. *Q-rejecting*
c. Jo didn't know {that, whether} Bo was smart. *Q-agnostic*

The Q-agnostic predicates in particular have been of interest in the syntax and semantics literature, in large part because they bear on a variety of important topics, including the interpretation of questions and the treatment of polysemy (Karttunen, 1977; Groenendijk and Stokhof, 1984; Heim, 1994; Ginzburg, 1995; Lahiri, 2002; George, 2011; Uegaki, 2015); but they are also interesting because a verb's Q-agnosticism appears to be predictable from the sorts of inferences that verb triggers about its embedded clause (cf. Hintikka, 1975).

Specifically, among the well-studied clause-embedding verbs there is a relatively strong correlation between whether a predicate is veridical—i.e. whether it entails the content of its embedded clause—and whether it is Q-agnostic (Egré, 2008). Veridical predicates, like *know*, *realize*, and *prove*, tend to be Q-agnostic (3a), and nonveridical predicates, like *believe*, *think*, and *hope*, tend not to be (3b).

(3) a. Jo {knows, realized, proved} that Bo is home. $\rightarrow$ Bo is home.
b. Jo {believes, thinks, hopes} that Bo is home. $\not\rightarrow$ Bo is home.

Indeed, Egré (2008) argues that this correlation is perfect: a predicate is Q-agnostic if and only if it is veridical. Defending this claim requires him to explain the apparent Q-agnosticism of two kinds of counterexamples: nonveridical communicative predicates, like *tell* (4a) and *agree* (4b); and nonveridical cognitive predicates, like our key example *decide* (4c), as well as adjectival predicates like *be certain* (4d).[2]

(4) a. Jo told Mo {that, whether} Bo was home.
b. Jo agreed with Mo {that, about whether} Bo was home.
c. Jo decided {that, whether} she should leave.
d. Jo wasn't certain {that, whether} she should leave.

Egré argues that (except for *tell*) none of the predicates in (4) are truly Q-agnostic. Rather, when they take a question, there is really a (sometimes silent) preposition mediating the relationship. Thus, Egré's revised generalization is that only veridicals can take both declaratives and interrogatives *directly*—i.e. without mediation by a preposition. As evidence for this position, he notes that predicates like *agree*, *decide*, and *be certain* all at least can mediate the syntactic relationship between a predicate and an interrogative via a preposition.

(5) a. Jo agreed with Mo about whether Bo was home.
b. Jo decided (about) whether she should leave.

[2]These are counterexamples to the *only if* direction. Egré also discusses counterexamples to the *if* direction, such as *be true* and *be right*. These are not relevant for current purposes.

c. Jo wasn't certain (about) whether she should leave.

This position is useful for integrating nonveridicals into the standard treatment of embedded interrogatives, which has that embedded interrogatives denote a true answer (Karttunen 1977; Groenendijk and Stokhof 1984; though see Hamblin 1973). We turn to this assumption next.

2.2. Veridicality, true answers, and possible answers

Veridicality has also played a key role in explaining the interpretation of embedded interrogatives, in the form of what we will call the *true-answers assumption*—the assumption that embedded interrogatives denote a set of true answers to the question. The true-answers assumption works well for predicates like *know*, which do indeed seem to relate individuals to true answers, and it would seem to connect directly to the above selectional hypothesis. Suppose, by the true-answers assumption, that (6) is true for all Q-agnostics V.

(6) **A true-answerhood constraint for Q-agnostics**
$\forall x, Q, w : [\![\mathrm{V}_{int}]\!]^w(Q)(x) \leftrightarrow \exists p \in \text{ANS}_{w@}(Q) : [\![\mathrm{V}_{decl}]\!]^w(p)(x)$
where $\text{ANS}_w(Q) = \{p \in Q : p(w)\}$ (cf. Dayal, 1996)

Then, we correctly predict (7) to be infelicitous: what Jo knows cannot fail to be wrong, since what she knows is, by definition, true—and in this case, uniquely true.

(7) Jo knew whether Bo was home, #but she was wrong.

Just as the veridical selectional hypothesis hits problems for nonveridicals, so of course does the true-answers assumption; these problems have been discussed for predicates like *agree* (8a) and of course *decide* (8b). Intuitively, such verbs do not seem to relate individuals to true answers (Beck and Rullmann, 1999; Lahiri, 2002); people might agree on a falsehood, or decide to do something impossible. If (6) were true for all Q-agnostics, then (8a) and (8b), like (7), should be infelicitous.

(8) a. Jo and Mo agreed about whether Bo was home, but they were both wrong.
b. Jo finally decided whether she would leave, but then she changed her mind.

Rather, these predicates seem to relate an individual to something like a *possible answer* (or set thereof): (8a) and (8b) are roughly paraphrasable as (9a) and (9b), respectively.

(9) a. Jo and Mo agree either that Bo is home or that he isn't.
b. Jo decided either that she would go or that she wouldn't.

But supposing that the denotation of, e.g., *about* (or its purported silent variant) acts to convert true answers to possible answers, then—on Egré's account—it makes sense that, insofar as a predicate does not relate an individual to true answers, it requires mediation by a preposition. On this view, then, *decide* (etc.) might not be exceptional in either its selectional behavior or interpretive behavior, and so might be consistent with a version of the true-answers assumption.

We provide two arguments against this treatment of the purportedly exceptional Q-agnostic/Q-selecting verbs. One reason to be doubtful of this story is that at least some nonveridical predicates do not allow mediation by any preposition. For instance, *estimate* is not veridical (10a), and *about* cannot mediate its relationship to a question (10b). Thus, an account such as Egré's needs to stipulate that certain verbs only take silent prepositions, which seems undesirable. We will avoid the assumption of lexically-specific silent pronouns here.

(10) a. Jo estimated that they would have enough money, but she was wrong.
b. Jo was trying to estimate (*about) whether they would have enough money.

A second problem is that the preposition that overtly mediates such cases most often is *about*; yet there is extensive evidence that *about*-phrases are modifiers of the verbs they combine with—not directly interacting with argument structure at all (Rawlins, 2013). In fact, Rawlins shows that the distribution of *about* is orthogonal to the selection of embedded interrogatives.

This leaves the question of what the interpretation is of the exceptional cases, like *decide* and *estimate*. One tack is to retain the standard approach to embedded questions and assume that, e.g., the predicate itself converts true answers to possible answers (cf. Beck and Rullmann, 1999; Lahiri, 2002). Another option is to say, instead, that all embedded questions denote possible answers and that, e.g., a predicate itself can convert possible answers to true answers (Spector and Egré, 2015). We will start from this second approach here.

Under the assumption that questions denote sets of complete possible answers—i.e. partitions on D_s—this second approach has the nice consequence that it correctly predicts veridical predicates to always relate individuals to true answers—the true-answerhood property follows from the veridicality entailment or presupposition.[3] To see this, suppose we define *(p-)veridicality* and *q-veridicality* as in (11) and that we replace the true-answerhood constraint in (6) with (12), which implements the possible-answers assumption for Q-agnostics V.

(11) a. $\textsc{p-veridical}(V) \leftrightarrow \forall x, p, w : [\![\mathrm{V}_{decl}]\!]^{w}(p)(x) \rightarrow p(w_{@})$
b. $\textsc{q-veridical}(V) \leftrightarrow \forall x, Q, w : [\![\mathrm{V}_{int}]\!]^{w}(Q)(x) \leftrightarrow [\![\mathrm{V}_{decl}]\!]^{w}(\textsc{ans}_{w_{@}}(Q))(x)$

(12) **A possible-answerhood constraint for Q-agnostics**
$\forall x, Q, w : [\![\mathrm{V}_{int}]\!]^{w}(Q)(x) \leftrightarrow \exists p \in Q : [\![\mathrm{V}_{decl}]\!]^{w}(p)(x)$

From this constraint, one can prove that a verb is q-veridical if it is p-veridical; see (13).

(13)
$$\begin{aligned}\forall x, Q : ([\![\mathrm{V}_{int}]\!]^{w}(Q)(x)\ \&\ \textsc{p-veridical}(V)) \rightarrow\ & \exists p \in Q : [\![\mathrm{V}_{decl}]\!]^{w}(p)(x)\ \&\ p(w_{@})\\ \equiv\ & \exists p \in \textsc{ans}_{w_{@}}(Q) : [\![\mathrm{V}_{decl}]\!]^{w}(p)(x)\\ \equiv\ & [\![\mathrm{V}_{int}]\!]^{w}(\textsc{ans}_{w_{@}}(Q))(x)\end{aligned}$$

[3]It falters, however, on many communicative predicates like *tell*, which appear to relate individuals to true answers but which are not veridical (though see discussion in Baker, 1968). There are various ways these predicates might be dealt with (Egré, 2008; Anand and Hacquard, 2014; Spector and Egré, 2015).

We follow Spector and Egré 2015 in suggesting that this situation is an improvement over the standard approach, since there are fewer stipulations (*modulo* some that Spector and Egré address), and so for the remainder of the paper, we assume the possible answers interpretation for questions. The next focus is to apply this hypothesis specifically to *decide*: if an interrogative embedded by *decide* denotes a set of possible answers, what does the lexical semantics of *decide* do with them?

3. Overgeneration for nonveridicals

We now show how to instantiate the possible-answers assumption into a particular lexical entry for *decide*. We first show that decisions involve the firming of intentions, and then discuss two key kinds of contexts where intentions can change with decisions, involving selection of intentions and changes of intentions; these lead to different selectional behaviors. In this process we make one further, final refinement to the possible-answers constraint.

3.1. Selecting and alternating contexts

First, note that (14) entails (15a) and (15b).

(14) At 3pm, Jo decided to leave at 5pm.

(15) a. It's false that, before 3pm, Jo intended to leave at 5pm.
b. It's true that, after 3pm, Jo did intend to leave at 5pm.

Given this evidence, (16) seems to be a good first approximation to the denotation of *decide to*. That is, the decider changes state from not having an intention to having one.

(16) $[\![\text{decide}_{decl}]\!]^t = \lambda p.\lambda x.\neg\text{INTEND}(x, p, \{t' : t' < t\})\ \&\ \text{INTEND}(x, p, \{t' : t' > t\})$
where $\text{INTEND}(x, p, T) \leftrightarrow x$ intends p over interval T

The possible-answers assumption allows us to infer from (16) to an interrogative embedding case; assuming the possible-answers constraint in (12), (17) must hold. The prediction is then that *decide whether to VP* entails either that the decider changed from not intending to VP to intending to VP, or they changed from not intending not to VP to intending not to VP.

(17) **Deciding WH** *version 1*
$[\![\text{decide}_{int}]\!]^t(Q)(x) \leftrightarrow \exists p \in Q : \neg\text{INTEND}(x, p, T_{<t})\ \&\ \text{INTEND}(x, p, T_{>t})$
where $T_{<t} \equiv \{t' : t' < t\}$ and $T_{>t} \equiv \{t' : t' > t\}$

This prediction is borne out: (18) does have an entailment of that form.

(18) At 3pm, Jo decided whether to leave at 5pm.

Despite this positive prediction, (17) needs one further refinement.

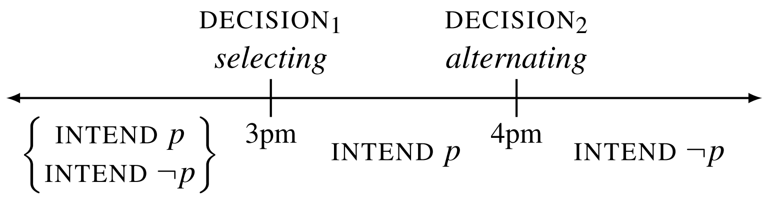

Figure 1: Schematization of selecting and alternating contexts

Note that *decide to VP* can describe two kinds of context: *selecting contexts* and *alternating contexts*. In a *selecting context*, a decider selects an intention from a set of possible intentions. For instance, suppose that, before 3pm, Jo neither intends to leave at 5pm nor intends not to leave at 5pm (schematized in Figure 1). (19) is felicitous in this context.

(19) At 3pm, Jo decided to leave at 5pm.

In an *alternating context*, a decider changes intention from a mutually exclusive intention. For instance, suppose that (19) is true, and thus before 4pm, Jo intends to leave at 5pm. (20) is both felicitous and true in this context.

(20) At 4pm, Jo decided not to leave at 5pm.

Contrast this pattern with *decide whether to*. Like (19), (21a) is a true description of DECISION$_1$. But unlike (20), (21b) is infelicitous in the alternating context. Intuitively it implies that Jo hadn't made a decision before 4pm.

(21) a. At 3pm, Jo decided whether to leave at 5pm.
b. #At 4pm, Jo decided whether to leave at 5pm.

The pattern seen with *decide* in selecting/alternating contexts is surprising if (17) exhausts the relevant set of entailments—and in particular, if the first conjunct is presupposed—since (17) predicts that (21b) should be true in this context. Indeed, (17) predicts that (20) entails (21b).

This infelicity appears to arise as a consequence of a presupposition failure similar to those found for, e.g., aspectual change-of-state verbs, such as *start* and *stop* (cf. Simons, 2001; Abusch, 2002; Abbott, 2006). For instance, *start p* presupposes $\neg p$, but this presupposition can be filtered in ignorance contexts, such as (22).

(22) I don't know if Jo used to smoke, but if she starts smoking, she'll get lung cancer.

We observe a similar pattern for *decide whether to VP* in ignorance contexts. If the speaker is not sure whether Jo already had an intention, (21b) is felicitous, suggesting that there is a similar presupposition being filtered; (23) illustrates such a filtering context.

(23) I don't know if, before 4pm, Jo already either intended to leave at 5pm or intended not to, but if, at 4pm, she decided whether to leave at 5pm, she'll follow through on it.

Thus, just like the aspectuals, it appears that the description of the state prior to the decision (the *pre-state*) is presupposed, and in the case of (21b), this presupposition is not satisfied. This is bolstered by the fact that *not decide to VP* is infelicitous in the context of DECISION_1.

(24) #At 3:30pm, John didn't decide to leave at 5pm.

Going forward, we thus assume that entailments about the pre-state are presupposed, though for presentational purposes, we write them as conjuncts on par with other predicates of events.

3.2. Taking change-of-state seriously

The issue with alternating contexts has a straightforward solution. *Decide whether to VP* does not involve just forming some intention towards an alternative where that was previously lacking, but rather moving from a state where the agent has no intentions towards a set of alternatives, to one where they do have intentions towards some alternative. At a technical level, this amounts to introducing a narrow-scoping existential quantifier into (17). This has the consequence that we now predict (21b) to be a false description of DECISION_2, since the first conjunct in (25) is false in a context where the decider already has an intention.

(25) **Deciding WH** *version 2*

$$[\![\text{decide}_{int}]\!]^t(Q)(x) \leftrightarrow \neg\exists p \in Q : \text{INTEND}(x, p, T_{<t}) \;\&\; \exists p \in Q : \text{INTEND}(x, p, T_{>t})$$

The point of (25) is not just to fix a data problem, though. Like (16), it takes the general form of a change-of-state predicate—i.e. there is some particular state R that does not hold of an individual x prior to the change characterized by the predicate that holds after the change. In the case of *decide p*, $R_p = \lambda x.\text{INTEND}(x, p)$; and in the case of, *decide Q*, $R_Q = \lambda x.\exists p \in Q : \text{INTEND}(x, p)$. (We suppress time parameters from now on, as they do not matter to our point.)

To summarize, in the interrogative-embedding case, a decision involves a presupposed pre-state entailment with a lack of intention relative to some set of alternatives and a post-state with an intention relative to those alternatives. In the declarative-embedding case, only the post-state is characterized, and the pre-state entailments fall out from there.

4. Our proposal

In this section, we present a compositional analysis that captures the interpretive facts presented in Section 3, while also capturing the argument selectional behavior of *decide*.

4.1. Generalization

We propose the following generalization: a predicate is Q-agnostic if (a) it is change-of-state and (b) the change it characterizes involves states associated with propositional content. Assuming Egré's generalization is correct, this is corroborated trivially by veridical change-of-

	Finite		**Control**		**AcI**	
	decl.	*interr.*	*decl.*	*interr.*	*decl.*	*interr.*
decide	✓	✓	✓	✓	✓	*
judge	✓	✓	*	✓	✓	*
infer	✓	✓	*	✓	✓	*
determine	✓	✓	*	✓	✓	*
estimate	✓	✓	*	✓	✓	*
diagnose	?	✓	*	✓	✓	*
conclude	✓	?	*	?	?	*
resolve	*	✓	?	✓	*	*
evaluate	?	✓	*	?	✓	*
appraise	?	✓	*	?	✓	*
rate	?	✓	*	?	✓	*
assess	✓	✓	*	?	?	*
choose	*	?	✓	✓	?	*
select	*	?	✓	✓	?	*
opt	*	*	✓	?	*	*
elect	*	*	✓	?	*	*

Table 1: The syntactic distribution of nonveridical change-of-state verbs

state predicates like *realize*, *discover*, *find out*, *figure out*, and *prove*; but it is also true of a host of nonveridical change-of-state predicates, such as those listed in Table 1.[4]

Beyond these positive examples, we also find negative examples, like *intend*. *Intend* is neither veridical nor change-of-state, and is not Q-agnostic.

(26) Jo intended (*whether) to leave.

Such negative examples are not critical for our generalization, but they are interesting for relating our proposal to Egré's (2008) veridicality generalization, discussed in Section 2. Many Q-agnostic predicates, both veridical and nonveridical, are change-of-state, but if one were to focus only on change-of-state predicates that involve changes in epistemic state—e.g. *realize*, *discover*, *find out*, *figure out*, etc.—it would at least be reasonable to say that those 'inherit' their Q-agnosticism from the fact that *know* is Q-agnostic. This would in turn explain the correlation between veridicality and Q-agnosticism. But because we do not have similar recourse here—*intend* is not veridical—we must say something else.

What binds the predicates in Table 1 together—to the exclusion of *intend*—is that they all involve selection from a set of mutually exclusive options: deciding involves selecting from a set of possible decisions; a judgment involves selecting from a set of possible judgments; and so

[4]Note that this assumes that the Q-agnostic predicates include all predicates that take both a question and an interrogative, regardless of other syntactic differences between the relevant declarative and interrogative—e.g. tense. For instance, predicates of evaluation like *evaluate*, *appraise*, and *rate* take AcI declaratives but not finite declaratives, despite taking both finite and control interrogatives.

$$
\begin{tikzcd}
e_{pre} \arrow[rr, "\text{DECIDE}"] \arrow[d, dash] & & e_{post} \arrow[d, dash] \\
\text{CONTENT} \arrow[d] & & \text{CONTENT} \arrow[d] \\
\{\text{INTEND } p_1, \text{INTEND } p_2, ...\} & & \text{INTEND } p_i \\
\textit{inquisitive} & & \textit{informative}
\end{tikzcd}
$$

Figure 2: A schematization of decisions in selecting contexts

on. The intuition behind our generalization is that, when taking an interrogative, the predicates in Table 1 use the question denoted by that interrogative to characterize the set of options from which the judger, decider, etc. selects. But when taking a declarative, these predicates use the propositions denoted by that declarative to characterize the selected option.

Figure 2 schematizes this idea for *decide*. We model decisions as three-place relations on eventualities: a *pre-state* (e.g. the decider's intentional state prior to the decision), the decision itself, and a *post-state* (e.g. the decider's intentional state after the decision). Then, embedded interrogatives characterize the *inquisitive content* of the pre-state, and embedded declaratives characterize the *informative content* of the post-state (cf. Hacquard, 2010; Rawlins, 2013).

We implement this idea compositionally by combining two recent approaches to verb meaning: (i) Champollion's (2015) verb-as-event-quantifier approach and (ii) Hacquard's (2010) neo-Davidsonian event content approach to propositional attitude verbs (cf. Kratzer, 2006; Moulton, 2009; Bogal-Allbritten, 2016).

4.2. Verbs as event quantifiers

In Champollion's approach, verbs are existential quantifiers over eventualities. For instance, (27) gives his denotation for *kiss* (p. 42, fig. 2).

(27) $[\![\text{kiss}]\!] = \lambda f_{\langle vt \rangle}.\exists e : f(e)\ \&\ \textsc{kiss}(e)$

Note that this approach assumes that all arguments are severed from the verb (cf. Kratzer, 1996; Borer, 2005; Pietroski, 2005). The denotations of adjuncts as well as the denotations of heads that introduce thematic roles (after combining with their argument) are then treated as (partial) functions from $D_{\langle vt \rangle t}$ to $D_{\langle vt \rangle t}$. For example, the THEME role would be introduced via a *th* head.

(28) $[\![[\text{th Jo}]]\!] = \lambda V_{\langle\langle vt \rangle t\rangle}.\lambda f_{\langle vt \rangle}.V(\lambda e.f(e)\ \&\ \textsc{theme}(e) = j)$

Important for our purposes is how change-of-state verbs work in this system. Champollion does not treat change-of-state verbs directly, though his denotation for the adverb *alternately* (p. 58, ex. 62), which incorporates change-of-state semantics, contains all the relevant components. We do not repeat his denotation here, since it involves more machinery than we need, rather extracting the relevant pieces to define a basic change-of-state verb *break* in (29).

(29) $[\![\text{break}]\!] = \lambda f_{\langle vt\rangle}.\exists e : f(e) \;\&\; \text{COS}(e, \text{BREAK}, \text{BROKEN})$
where $\text{COS}(e,g,h) \equiv \exists e_1, e_2 : e_1 \supset\subset e \supset\subset e_2 \;\&\; g(e,e_1,e_2) \;\&\; \neg h(e_1) \;\&\; h(e_2)$
$e_1 \supset\subset e_2 \equiv \sup \tau(e_1) = \inf \tau(e_2)$ (assuming time is dense)

For the remainder of the paper, we assume that change-of-state verbs have a form parallel to (29). Effectively, to know the denotation for a change-of-state verb, we need to know two things: (i) the eventuality predicate that characterizes the change (e.g. BREAK); and (ii) the eventuality predicate that characterizes the state that changes (e.g. BROKEN). We assume that (i) carries any entailments that are idiosyncratic to a particular kind of state change—e.g. that the holder of the states characterized by (ii) is the same as the patient/theme of the state change.

In certain cases (including *decide* and other Q-agnostic change-of-state predicates), the second component may be supplied by external material. For instance, at least for aspectual verbs like *start* and *stop*, the state that changes appears to be characterized by the embedded clause.

(30) Jo started to run at 5pm. → Jo was not running before 5pm and was running after 5pm.

Thus, it appears that we need some way of feeding the embedded clause content to the first argument of COS. One way to do this is to assume that *start* maps from event quantifiers to event quantifiers, instead of being an event quantifier itself. This route, the analogue of which we employ for *decide*, is taken in (31a). Assuming for the moment that the infinitival *to* is the identity on event quantifiers (31b), the denotation of the VP headed by *start* in (30) is (31c).

(31) a. $[\![\text{start}]\!] = \lambda V_{\langle\langle vt\rangle t\rangle}.\lambda f_{\langle vt\rangle}.\exists e : f(e) \;\&\; \text{COS}(e, \text{START}, \lambda e_1.V(\lambda e_2.e_1 = e_2))$
b. $[\![\text{to run}]\!] = [\![\text{run}]\!] = \lambda f_{\langle vt\rangle}.\exists e : f(e) \;\&\; \text{RUN}(e)$
c. $[\![\text{start to run}]\!] = \lambda f_{\langle vt\rangle}.\exists e : f(e) \;\&\; \text{COS}(e, \text{START}, \lambda e_1.\exists e_2 : e_1 = e_2 \;\&\; \text{RUN}(e_2))$
$= \lambda f_{\langle vt\rangle}.\exists e : f(e) \;\&\; \text{COS}(e, \text{START}, \text{RUN})$

In this case, the predicate that characterizes the state change, START, might enforce identity between the agent of the starting and the agent of the running—insofar as aspectuals are control verbs (see Perlmutter, 1970; Landau, 2001; Wurmbrand, 2001; Grano, 2012).

4.3. Quantification over eventuality contents

In Hacquard's approach, propositional attitude verb denotations have three components: (i) an experiencer thematic role, (ii) a predicate of eventualities, and (iii) a universal quantification over the (intersection of the) contents of the attitude eventuality (cf. Hintikka, 1962). For instance, (32) gives a slightly modified version of her denotation for *believe* (p. 101, ex. 41).

(32) $[\![\text{believe}]\!] = \lambda e.\lambda p.\lambda x.\text{EXP}(e) = x \;\&\; \text{BELIEF}(e) \;\&\; \forall w \in \cap\, \text{CON}(e) : p(w)$
where $\forall e : \text{CON}(e) = \{p : p \text{ is compatible with the contents of } e\} \;\&$
$\forall e : \text{BELIEF}(e) \rightarrow [\text{CON}(e) \equiv \text{DOX}(\text{EXP}(e))]$

Importantly, CON must be defined as a partial function from events to quantifiers over worlds—

i.e. questions—in order to ensure that non-information state events do not end up with contents.

We say that an eventuality *e has (propositional) content* if $\text{CON}(e)$ is defined. We say that the content of an eventuality is *informative* with respect to a question Q iff $\exists p \in Q : \bigcap\text{CON}(e) \subseteq p$; otherwise, it is *non-informative*. In the case where it is non-informative, the question Q can be viewed as *inquisitive* relative to the content.[5] Since the last conjunct in (32) continues to arise for the change-of-state verbs we are interested in, it is useful to give it the shorthand in (33).

(33) $\forall e, p : \text{CON}(e) \text{ is defined} \rightarrow \left[e \overset{\text{CON}}{\Longrightarrow} p \leftrightarrow \forall w \in \bigcap \text{CON}(e) : p(w)\right]$

We refer to the relation $\overset{\text{CON}}{\Longrightarrow}$ as *content entailment* and say that *e content-entails p*.

4.4. Merging the approaches

To merge these two approaches, we propose the form in (34a) for a basic stative propositional attitude verb such as *believe* or *intend*.

(34) a. $[\![\text{believe}]\!] = \lambda p.\lambda f_{\langle vt\rangle}.\exists e : f(e) \;\&\; \text{BELIEF}(e) \;\&\; e \overset{\text{CON}}{\Longrightarrow} p$

b. $[\![\text{intend}]\!] = \lambda p.\lambda f_{\langle vt\rangle}.\exists e : f(e) \;\&\; \text{INTENTION}(e) \;\&\; e \overset{\text{CON}}{\Longrightarrow} p$

The main difference between this denotation and Hacquard's is the sublexical quantification over eventualities and the lack of an experiencer thematic role. The main difference between this denotation and Champollion's is that propositional attitude verbs take a proposition in addition to an eventuality predicate, which is already plausibly necessary for aspectuals.[6]

Next, we define what it means for an event to content-entail a question. The definition in (35) is effectively a reencoding of the rule in (12) from Section 2. An eventuality content-entails a question just in case that eventuality content-entails some answer to that question—i.e. the content is informative relative to the question.[7]

[5] A different strategy, following Rawlins (2013), would be to allow contents themselves to be of a type that is rich enough to define inquisitivity (see, e.g., Ciardelli et al. 2013; Rawlins 2013). Here we stick with Hacquard's treatment, where it is always propositional.

[6] Another possible approach is to retain the event quantifier analysis even for propositional attitude verbs and aspectuals and assume, e.g., that complementizers selected by propositional attitude verbs have the form in (i), where p is contributed by the denotation of the constituent that combines with the complementizer (cf. Kratzer, 2006; Moulton, 2009; White, 2014; Bogal-Allbritten, 2016).

(i) $[\![\text{C}_p]\!] = \lambda p.\lambda V_{\langle\langle vt\rangle t\rangle}.\lambda f_{\langle vt\rangle}.V\left(\lambda e.f(e) \;\&\; e \overset{\text{CON}}{\Longrightarrow} p\right)$

Aspectuals would then need some complementizer that amounts to existential disclosure (Dekker, 1993).

This denotation is analogous to Champollion's thematic role denotations, differing in that Champollion's thematic role takes entity quantifiers whereas ours takes propositions. To make ours fully analogous, we could assume (ii) instead, where $\mathscr{Q}$ is some first order quantifier.

(ii) $[\![\text{C}_{\mathscr{Q}}]\!] = \lambda Q.\lambda V_{\langle\langle vt\rangle t\rangle}.\lambda f_{\langle vt\rangle}.V\left(\lambda e.f(e) \;\&\; \mathscr{Q}p \in Q : e \overset{\text{CON}}{\Longrightarrow} p\right)$

This would imply that complementizers are type-identical to thematic roles, except that they take quantifiers over worlds—i.e. questions—instead of quantifiers over events.

[7] The notion of content-entailment in (35) may or may not be relevant for predicates that only take questions—

(35) $\forall e, Q : \text{CON}(e) \text{ is defined} \rightarrow \left[e \overset{\text{CON}}{\Longrightarrow} Q \leftrightarrow \exists p \in Q : e \overset{\text{CON}}{\Longrightarrow} p\right]$

We use this overloaded version of $\overset{\text{CON}}{\Longrightarrow}$ to give a straightforward denotation for *decide* with *ad hoc polymorphism*—i.e. $[\![\text{decide}]\!]$ is agnostic about the type of its first argument R.

(36) $[\![\text{decide}]\!] = \lambda R_\tau.\lambda f_{\langle vt\rangle}.\exists e : f(e)\ \&\ \text{COS}(e, \text{DECIDE}, \lambda e'.e' \overset{\text{CON}}{\Longrightarrow} R)$
where $\tau \in \{\langle st\rangle, \langle\langle st\rangle t\rangle\rangle\}$

The relation $\text{DECIDE}(e, e_1, e_2)$ must entail at least two things of the eventualities it relates. First, it must entail that e_1 and e_2 are states with intentional contents, i.e. whose contents are sets of propositions characterizing some experiencer's intentions. Second, it must entail that the experiencer of those intentions is the agent/experiencer of the decision e.

To ensure that $[\![\text{decide}]\!]$ combines with a proposition or question, we assume that $[\![\text{to VP}]\!] = \lambda w.[\![\text{VP}]\!](\lambda e.e \in D_v^w)$, where D_v^w is the set of events in world w (cf. White, 2014). Then, when *decide* takes a declarative, we obtain a denotation of the form in (37).

(37) $[\![\text{decide to leave}]\!] = \lambda f_{\langle vt\rangle}.\exists e : f(e)\ \&\ \text{COS}(e, \text{DECIDE}, \lambda e'.e' \overset{\text{CON}}{\Longrightarrow} R)$
where $R = \lambda w.\exists e' \in D_v^w : \text{LEAVE}(e')$

Assuming that the introduction of a subject merely contributes a conjunct $\text{EXP}(e) = c$ for some constant c (and ignoring tense), $[\![(37)]\!]$ entails (39), which is consistent with the pattern of entailments discussed in Section 3. Keep in mind that for *decide* CON contains propositions describing intentions, so the intersection is the set of worlds compatible with the agent's intentions during that eventuality. The pre-state content does not entail the proposition R (it may be compatible with it in selecting contexts, or entirely inconsistent in alternating contexts). The post-state's content does entail R.

(38) Jo decided to leave.

(39) $$\begin{aligned}\exists e, e_1, e_2 : e_1 \supset\subset e \supset\subset e_2\ &\&\ \text{DECIDE}(e, e_1, e_2)\\ &\&\ \neg\forall w \in \cap\, \text{CON}(e_1) : \exists e_3 \in D_v^w : \text{LEAVE}(e_3)\\ &\&\ \forall w \in \cap\, \text{CON}(e_2) : \exists e_4 \in D_v^w : \text{LEAVE}(e_4)\end{aligned}$$

When *decide* takes an interrogative, we obtain a denotation of the form in (40).

(40) $[\![\text{decide whether to leave}]\!] = \lambda f_{\langle vt\rangle}.\exists e : f(e)\ \&\ \text{COS}(e, \text{DECIDE}, \lambda e'.e' \overset{\text{CON}}{\Longrightarrow} R)$
where $R = \{\lambda w.\exists e'' \in D_v^w : \text{LEAVE}(e''), \lambda w.\neg\exists e'' \in D_v^w : \text{LEAVE}(e'')\}$

Under the same assumption (and again ignoring tense), $[\![(40)]\!]$ entails (42), which is consistent with the pattern of entailments discussed in Section 3.

e.g. *wonder* and *ask*. We remain agnostic about this possibility, since we only intend to treat Q-agnostics here.

(41) Jo decided whether to leave.

(42) $$\exists e, e_1, e_2 : e_1 \supset\subset e \supset\subset e_2 \ \&\ \textsc{decide}(e, e_1, e_2)$$
$$\&\ \neg\exists p \in R : \forall w \in \cap\, \textsc{con}(e_1) : p(w)$$
$$\&\ \exists p \in R : \forall w \in \cap\, \textsc{con}(e_2) : p(w)$$
$$\textit{where } R = \{\lambda w.\exists e'' \in D_v^w : \textsc{leave}(e''), \lambda w.\neg\exists e'' \in D_v^w : \textsc{leave}(e'')\}$$

That is, the pre-state does not content-entail the question, and thus the question R is inquisitive relative to the pre-state's content (and therefore the agent's intentions at that time); this isn't compatible with an alternating context, but is compatible with a selecting context. The post-state, on the other hand, is informative relative to the question; in other words, the agent's intentions during that state resolve the question completely. We thus capture the full pattern of intuitions for *decide*.

5. Conclusion

In this paper, we have given an account of the selectional behavior of cognitive change-of-state verbs, such as *decide*, that attempts to reduce their selectional behavior to their change-of-state event structure. In particular, we argued that, if a cognitive verb is change-of-state, it is *Q-agnostic*—i.e. it selects both declarative and interrogative clauses. This augments previous accounts of Q-agnosticism, which have tied the distribution of declarative and interrogative clauses to semanticopragmatic notions like factivity and veridicality but which run aground on nonveridical predicates like *decide*.

In the remainder of the paper, we briefly consider the prospect of generalizing this approach to other kinds of nonveridical Q-agnostic predicates—e.g. communication predicates like *tell* and *agree*—and relating it to previous theories of Q-agnosticism for veridical predicates.

5.1. Nonveridical communicatives

We noted in Section 2 that communication verbs, like *tell* and *agree*, are Q-agnostic but not veridical. There are two fruitful routes for explaining these verbs on our proposal, both of which use Anand and Hacquard's (2014) neo-Davidsonian account of communicative predicates. On their account, communicatives characterize future states of some common ground (cf. Farkas and Bruce, 2009). For instance, (43) gives a modified version of their entry for *claim*.

(43) $$[\![\text{claim}]\!] = \lambda p.\lambda f_{\langle vt\rangle}.\exists e : f(e)\ \&\ \textsc{claim}(e)\ \&\ e \overset{\textsc{con}}{\Longrightarrow} \lambda w.[\forall w' \in \textsc{cg}(w) : p(w')]$$
$$\textit{where } \forall e : \textsc{claim}(e) \rightarrow [\textsc{con}(e) \equiv \textsc{goal}(e)]$$

One possibility, raised by Valentine Hacquard (p.c.), is that a subset of communicative predicates—*tell* but not *claim*—characterize not only future states of the common ground but also the Question Under Discussion of the reported discourse. Then, when such a communicative verb takes a question, that question characterizes that Question Under Discussion.

Another possibility is that, while all communicative predicates characterize future states of the common ground, only a subset characterize a change to that common ground. Insofar as a particular communicative predicate characterizes such a change, e.g. *agree*, our account predicts that those predicates are Q-agnostic.

5.2. Cognitive factives

As it stands, our account, in conjunction with Egré's (2008), redundantly predicts change-of-state factives to be Q-agnostic, since they are both veridical and change-of-state.

(44) $[\![\text{realize}]\!] = \lambda R_\tau.\lambda f_{\langle vt\rangle}.\exists e : f(e)\ \&\ \text{COS}(e, \text{REALIZE}, \lambda e'.e' \overset{\text{CON}}{\Longrightarrow} R)$
where $\tau \in \{\langle st\rangle, \langle\langle st\rangle t\rangle\}$

This raises the possibility that one or the other property is actually relevant in determining their Q-agnosticism. Is it possible to reduce the Q-agnosticism of change-of-state cognitive factives to the fact that they are change-of-state? There are at least two challenges for such a theory. The first is that stative cognitive factives like *know* are Q-agnostic. This means that the theory cannot tie Q-agnosticism too closely to change-of-state. The second challenge is that change-of-state is independent of factivity or veridicality—e.g. compare the factive *find out* to the nonfactive, nonveridical *determine*.

We suggest a generalization of the change-of-state hypothesis—that Q-agnosticism is really a product of having a particular kind of bipartite lexical semantic structure, one relating two encapsulated eventualities. Being change-of-state is one way that a verb can come to have that structure, but not the only one. Kratzer (2002) suggests that factives express relations between entities and facts as well as some auxiliary relation describing, e.g., the entity's beliefs about the fact (*know*) or how the entity came to be related to the fact (*discover*, *realize*, etc.). This contrasts with a nonfactive stative, like *intend*, which does not have such a bipartite structure.

This idea might be implemented using George's (2011) Twin Relations Theory, which similarly treats Q-agnostic predicates like *know* using ad hoc polymorphism. In George's theory, Q-agnostic predicates are constructed from two abstract elementary relations $R_\forall$ and $R_\exists$. For instance, (45) gives a translation of the relevant relations for *know*, $\text{KNOW}_\forall$ and $\text{KNOW}_\exists$, into our neo-Davidsonian formalism, and (46) shows how denotations for the declarative-taking and interrogative-taking variants of *know* are built from these relations.

(45) a. $\text{KNOW}_\forall \equiv \lambda p.\lambda e.\lambda w.\text{BELIEF}(e)\ \&\ \left[e \overset{\text{CON}}{\Longrightarrow} p\right] \rightarrow p(w)$

b. $\text{KNOW}_\exists \equiv \lambda p.\lambda e.\text{KNOW}(e)\ \&\ e \overset{\text{CON}}{\Longrightarrow} p$

(46) a. $[\![\text{know}_{decl}]\!]^w = \lambda p.\lambda f.\exists e_1, e_2 : f(e)\ \&\ \text{KNOW}_\forall(p)(e_1)(w)\ \&\ \text{KNOW}_\exists(p)(e_2)$

b. $[\![\text{know}_{int}]\!]^w = \lambda Q.\lambda f.\exists e_1, e_2 : f(e)\ \&\ \forall p \in Q : \text{KNOW}_\forall(p)(e_1)(w)$
$\&\ \exists p \in Q : \text{KNOW}_\exists(p)(e_2)$

Effectively, KNOW$_\forall$ characterizes the veridical entailments of *know*, while KNOW$_\exists$ characterizes the asserted content. This theory is straightforwardly portable to change-of-state predicates, such as *decide*.

(47) a. $\text{DECIDE}_\forall \equiv \lambda p.\lambda e.\lambda e'.e \supset\subset e' \;\&\; \neg \left[e \overset{\text{CON}}{\Longrightarrow} p\right]$

b. $\text{DECIDE}_\exists \equiv \lambda p.\lambda e.\lambda e'.e \supset\subset e' \;\&\; e \overset{\text{CON}}{\Longrightarrow} p$

(48) a. $[\![\text{decide}_{decl}]\!]^w = \lambda p.\lambda f.\exists e : f(e) \;\&\; \exists e_1, e_2 : \text{DECIDE}(e, e_1, e_2)$
$\&\; \text{DECIDE}_\forall(p)(e_1)(e)$
$\&\; \text{DECIDE}_\exists(p)(e)(e_2)$

b. $[\![\text{decide}_{int}]\!]^w = \lambda Q.\lambda f.\exists e : f(e) \;\&\; \exists e_1, e_2 : \text{DECIDE}(e, e_1, e_2)$
$\&\; \forall p \in Q : \text{DECIDE}_\forall(p)(e_1)(e)$
$\&\; \exists p \in Q : \text{DECIDE}_\exists(p)(e)(e_2)$

There are two potential upshots to such a reimplementation. First, (48) provides equivalent denotations to those given in Section 4. Second, for *know*, the conjunct containing KNOW$_\forall$ corresponds to the presupposed content and the conjunct containing KNOW$_\exists$ corresponds to the asserted content. This may suggest a more general pattern, wherein verbs with bipartite event structures always presuppose some universally quantified presupposition when they take an interrogative clause, be it a presupposition about facts or a presupposition about intentions.

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Only meets vagueness[1]

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Abstract. An *only* sentence is construed to consist of the positive component, also referred to as the *prejacent* and the negative one. It is uncontroversial that the negative component is part of the literal meaning, or entailment of the *only* sentence. More controversial is the status of the prejacent, for it can be canceled (only epistemically, not directly) unlike the negative component; in the literature, it has been analyzed as entailment, presupposition, or conversational implicature. In this paper, novel data on the cancellability of the prejacent will be proffered to indicate that the prejacent is not always cancelable, but is sensitive to the vagueness of the main predicate, suggesting that the cancelability of the prejacent has nothing to do with the semantics of *only* per se. Indeed, couched in a dynamic semantic framework of vagueness, an alternative analysis of an *only* sentence will be presented, in which along with the negative component, the prejacent is part of the literal meaning of the sentence; however, sometimes, it will not be categorically *asserted*, or will be partly revoked as the speaker is aware of the possibility that the object in question does not satisfy the standard of the absolute use of the (vague) main predicate.

Keywords: *only*, prejacent, cancelation, vagueness, dynamic semantics

1. Introduction

In the literature, it is uncontroversial that the interpretation of an *only* sentence, e.g., (1a) is composed of the positive component also referred to as the *prejacent*, (1b) and the negative component, (1c).

(1) a. Only John smokes.
    b. John smokes.
    c. Nobody except for John smokes.

Schematically, an *only* sentence, its prejacent and its negative component are represented in terms of background-focus notation as (2a), (2b), and (2c), respectively.

(2) a. $ONLY\langle F, B\rangle$
    b. Prejacent: $B(F)$
    c. Negative Component: $\forall x[[x \in ALT(F) \land x \neq F] \longrightarrow \neg B(F)]$

Controversial is the status of the prejacent—i.e., whether it is an entailment (e.g., Atlas 1993, 1996), a presupposition (e.g., Geurts and van der Sandt 2004; Horn 1969, 1996; Rooth 1985, 1992), or a conversational implicature (e.g., Ippolito 2007; McCawley 1981, van Rooij and Schulz 2007) of an *only* sentence.

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One of the most compelling pieces of evidence against the entailment and presupposition approaches is the cancellability of the prejacent observed in, e.g., (3).

(3) a. Only Mary can speak French … maybe she cannot.
b. Only John is tall … maybe he is not.

However, a look at further data reveals that the prejacent is not always cancelable; it is cancelable only when the main predicate is a vague one as seen in (3) and (4) in conjunction with (5) and (6).

(4) a. #Only Mary came to the party … maybe she didn't.
b. #Only John is married … maybe he is not.

(5) a. Mary can speak French very well.
b. John is very tall.

(6) a. *Mary came to the party very much.
b. *John is very married.

Data like (3) and (4) together are baffling to all the three existing approaches, for they cannot explain why the prejacent is cancellable sometimes and non-cancellable other times. In this paper, couched in a dynamic semantic framework for vagueness proposed by Barker (2002, 2013), I will present an analysis of the interpretation of an *only* sentence—in which the prejacent is indeed part of the semantic meaning of an *only* sentence but is not (categorically) asserted when the main predicate is a vague one.

Before moving on to the presentation of the current analysis, one more word is in order about the cancelability of the prejacent of an *only* sentence. That is, the prejacent is cancelable only epistemically as seen in the contrast between (7a) and (7b), and unlike the case of the cancelation of a conversational implicature in (7c).

(7) a. Only Mary can speak French … maybe, she can't.
b. #Only Mary can speak French … she can't.
c. Mary has three children … (actually,) she has exactly five children.

2. A novel analysis of the cancelability of the prejacent

It has been seen above that the prejacent of an *only* sentence is not always cancelable; the cancelation is possible only if the main predicate of the sentence is a vague one. This certainly suggests that the cancelation has no bearing on the semantics of an *only* sentence, or *only*. Indeed, in the current analysis to be proposed in the following, I will adopt such a semantics for *only* that both the prejacent and the negative component are hardwired in the literal meaning of (an) *only* (sentence), but after the utterance of an *only* sentence, the prejacent can be partly revoked, or can be not categorically asserted as the speaker becomes aware of the possibility that the focused object in question does not satisfy the standard for the absolute use of the (vague) predicate.

2.1. Semantics of *only*

Demonstrated by the contrast between (3) and (4), the prejacent of an *only* sentence is not always cancelable; it is cancelable only when the main predicate is a vague one. This strongly suggests that the prejacent is in fact part of the literal meaning of (an) *only* (sentence), but can be canceled (epistemically) from an interaction with vagueness. For the purpose of the present paper, any reasonable semantics of *only* with both the prejacent and the negative component incorporated will do, e.g., van Rooij and Schulz's (2007) $ONLY$, which is actually the penultimate version of their final proposed semantic meaning of *only*.

(8) Definition (van Rooij and Schulz's (2007) *ONLY*)
$ONLY(\langle F, B\rangle) = \{w \in W: F(w)\big(B(w)\big) \,\&\, \neg\exists v\big[F(v)\big(B(v)\big) \,\&\, v <_B w\big]\}$,
where $<_B$ is a relation on W such that $v <_B w$ iff v is exactly like w except that the extension of B in v is smaller than that in w, i.e., $B(v) \subset B(w)$.

According to the definition of the meaning of an *only* sentence, e.g., *Only Mary can speak French*, whose semantic representation in terms of the focus-background notation is $ONLY(\langle Mary, \lambda x. can\ speak\ French(x)\rangle)$ is the set of possible worlds whose extension of $\lambda x. can\ speak\ French(x)$ is the set that contains Mary as its sole element; in other words, where Mary and nobody else can speak French. The meaning corresponds with the propositional content composed of both the prejacent and the negative component.

2.2. Semantic framework for vagueness: Barker (2002, 2013)

As a general semantic framework for the interpretation of sentences involving vague predicates, I will adopt a dynamic semantic framework proposed by Barker (2002, 2013). In the framework, the utterance of a sentence updates information states, here modeled as sets of ordered pairs of possible worlds and discourses, not just sets of possible worlds, having the schematic form $\{\langle w, \boldsymbol{d}\rangle: ...\}$. The role of a discourse, among others, is to determine the standard for the absolute use of a vague predicate; that is, given a discourse, $\boldsymbol{d}$, a possible world, w, and a vague predicate, say *tall*, $\boldsymbol{d}(w)(\llbracket tall\rrbracket)$ specifies the standard of tallness in w and $\boldsymbol{d}$. In the setting, for example, *John is tall* is true in $\langle w, \boldsymbol{d}\rangle$, i.e., $\llbracket John\ is\ tall\rrbracket^{w,\boldsymbol{d}} = 1$ iff the degree of John's height is equal to or greater than the standard of tallness in w and $\boldsymbol{d}$, which is:

(9) $\llbracket John\ is\ tall\rrbracket^{w,\boldsymbol{d}} = 1$ iff $\iota e\big[\llbracket tall\rrbracket^{w,\boldsymbol{d}}(j)(e)\big] \geq \boldsymbol{d}(w)(\llbracket tall\rrbracket)$,
where ι is the iota operator and e is a degree variable.

And the utterance of a sentence updates a given information state into an information state in whose ordered pairs of possible worlds and discourses the sentence is true, as illustrated with *John is tall* as an example in the following:

(10) $C + \text{"}John\ is\ tall\text{"} = C' = \big\{\langle w, \boldsymbol{d}\rangle \in C: \llbracket John\ is\ tall\rrbracket^{w,\boldsymbol{d}} = 1\big\} = \big\{\langle w, \boldsymbol{d}\rangle \in C: \iota e\big[\llbracket tall\rrbracket^{w,\boldsymbol{d}}(j)(e)\big] \geq \boldsymbol{d}(w)(\llbracket tall\rrbracket)\big\}$

The update of an information state by the utterance of an *only* sentence, in this case *Only John is tall*, is illustrated as follows:

(11) $C + \text{"}Only\,John\,is\,tall\text{"} = C' = \{\langle w, \boldsymbol{d}\rangle \in C{:}\, [\![Only\,John\,is\,tall]\!]^{w,\boldsymbol{d}} = 1\} = \{\langle w, \boldsymbol{d}\rangle \in C{:}\, [\![John\,is\,tall]\!]^{w,\boldsymbol{d}} = 1 \wedge \forall x[x \neq j \rightarrow \iota e[[\![tall]\!]^{w,\boldsymbol{d}}(x)(e)] < \boldsymbol{d}(w)([\![tall]\!])\} = \{\langle w, \boldsymbol{d}\rangle \in C{:}\, \iota e[[\![tall]\!]^{w,\boldsymbol{d}}(j)(e)] \geq \boldsymbol{d}(w)([\![tall]\!]) \wedge \forall x[x \neq j \rightarrow \iota e[[\![tall]\!]^{w,\boldsymbol{d}}(x)(e)] < \boldsymbol{d}(w)([\![tall]\!])\}$

2.3. A post-update operation: *On Second Thought (OST)*

When the prejacent of an *only* sentence is canceled, the *only* sentence is characteristically followed by a pause, which is expressed typographically as "…" before the cancelation, as seen in (2) and the examples in the literature in general. I take the pause to signify the speaker's having second thoughts about the standard for someone or something to be determined to have the property in question, i.e., she has been suspecting that the standard can be more stringent than she originally assumed and has decided to take precautions against such a possibility.

I propose that there should be a post-update operation on information states that will incorporate the possibility that the standard of the property in question is stricter than originally assumed. The operator is a function on information states and properties as its arguments and is named *On Second Thought (OST)*.

(12) Definition (*OST*)
$OST(C', [\![B]\!]) = \{\langle w, \boldsymbol{d}'\rangle{:}\, \exists \boldsymbol{d}[\langle w, \boldsymbol{d}\rangle \in C' \wedge \boldsymbol{d}' \geq_{w,[\![B]\!]} \boldsymbol{d}]\}$,
where C' is an information state, B is the background predicate in question, and $\geq_{w,[\![B]\!]}$ is a relation on the domain of discourses, D such that $\boldsymbol{d}' \geq_{w,[\![B]\!]} \boldsymbol{d}$ iff $\boldsymbol{d}'$ is exactly like $\boldsymbol{d}$ possibly except that $\boldsymbol{d}'(w)([\![B]\!]) \geq \boldsymbol{d}(w)([\![B]\!])$.

Given an information state and a property, the application of *OST* on the information state with respect to the property results in an information state such that it contains ordered pairs of a possible world and a discourse that are exactly like ones contained in the input information state with the possible exception that the discourse is stricter with regard to the standard for the absolute use of the property in the world.

Let us see the effects of *OST* on the information state resulting from the utterance of an *only* sentence, e.g., *Only John is tall*, i.e., (11), with respect to the property $[\![tall]\!]$.

(13) $OST(C + \text{"}Only\,John\,is\,tall\text{"}, [\![tall]\!]) = OST((10), [\![tall]\!]) = \{\langle w, \boldsymbol{d}'\rangle{:}\, \exists \boldsymbol{d}[\langle w, \boldsymbol{d}\rangle \in C \wedge \iota e[[\![tall]\!]^{w,\boldsymbol{d}}(j)(e)] \geq \boldsymbol{d}(w)([\![tall]\!]) \wedge \forall x[x \neq j \rightarrow \iota e[[\![tall]\!]^{w,\boldsymbol{d}}(x)(e)] < \boldsymbol{d}(w)([\![tall]\!])] \wedge \boldsymbol{d}' \geq_{w,[\![tall]\!]} \boldsymbol{d}\}$

The resulting information state is such that nobody other than John is tall in all the ordered pairs of possible worlds and discourses that are elements of the information state; in some of the ordered pairs John is tall and in the others John is not tall.

2.4. Veltman's (1996) update semantics

Veltman (1996) developed a dynamic-semantic framework to analyze epistemic modals and default reasoning. Relevant to the following discussion is his analysis of epistemic modals, especially the epistemic possibility modal '$might$', which I take to model *maybe*, which characteristically appears in the sentences canceling the prejacent of an *only* sentence as in (3).

Here I will introduce a minimum portion of Veltman's (1996) dynamic-semantic framework that is sufficient for the current issues and is adapted to the terms of the previous sections. Given an information state C and a sentence ϕ, the update of C by (the utterance of) ϕ is basically as we have assumed above, i.e., intersecting C with the propositional content of ϕ; consequently, the resulting information state is usually a proper subset of C, as in the cases of, e.g., (10) and (11). One of the exceptional cases is a sentence of the form $might\ \psi$ with the epistemic operator $might$ prefixed. Following is the definition of the update effected by $might\ \psi$.

(14) Definition (Update Function of $might\ \psi$)
Let C be an information state and $might\ \phi$ be a sentence composed of an operator $might$ and a sentence ψ.
$C + might\ \psi = C$ if $C + \psi \neq \emptyset$. (Otherwise, i.e., if $C + \psi = \emptyset$, $C + might\ \psi = \emptyset$.)

As is clear from the definition, the update by $might\ \phi$ is actually not an "update", for the resulting information state is the same as the input one (or the "absurd" state, i.e., $\emptyset$). Veltman characterizes the function of $might\ \phi$ as a *test*, by which you just see if the current information state is compatible with ϕ.

From the perspective of whether someone in a given information state accepts a given sentence and whether the sentence is acceptable to her, the two relations between information states and sentences, i.e. *acceptance* and *acceptable* were defined as follows:

(15) Definition (*Acceptance*)
Let C be an information state and ϕ be a sentence. ϕ is *accepted* in C ($C \Vdash \phi$) iff $C + \phi = C$ (which intuitively says that the propositional information of ϕ is already subsumed by C).

(16) Definition (*Acceptable*)
Let C be an information state and ϕ be a sentence. ϕ is *acceptable* in C iff $C + \phi \neq \emptyset$ (which intuitively says that the propositional information of ϕ is not rejected by C).

From the definitions of the update function of a sentence of the form $might\ \phi$, *acceptance* and *acceptable*, it follows that $might\ \psi$ is accepted in C iff ψ is acceptable in C.

2.5. Veltman's (1996) $might$ for *maybe* and *acceptance* for felicitous continuation

Having reviewed Veltman's (1996) update semantics, I propose that the modal adverb that characteristically appears with the sentence suspending the prejacent, i.e., *maybe* should be modeled as Veltman's $might$, and the felicitous continuation as Velman's *acceptance*.

2.5.1. The case of an *only* sentence with a vague predicate

Let us take *Only John is tall* as an *only* sentence with a vague predicate. As shown above, the information state resulting from updating a given information state C with the utterance of the sentence is (11), which is reproduced here:

(11) $C + \text{"}Only\,John\,is\,tall\text{"} = C' = \{\langle w, \boldsymbol{d}\rangle \in C\colon [\![Only\,John\,is\,tall]\!]^{w,\boldsymbol{d}} = 1\} = \{\langle w, \boldsymbol{d}\rangle \in C\colon [\![John\,is\,tall]\!]^{w,\boldsymbol{d}} = 1 \wedge \forall x[x \neq j \rightarrow \iota e[[\![tall]\!]^{w,\boldsymbol{d}}(x)(e)] < \boldsymbol{d}(w)([\![tall]\!])\} = \{\langle w, \boldsymbol{d}\rangle \in C\colon \iota e[[\![tall]\!]^{w,\boldsymbol{d}}(j)(e)] \geq \boldsymbol{d}(w)([\![tall]\!]) \wedge \forall x[x \neq j \rightarrow \iota e[[\![tall]\!]^{w,\boldsymbol{d}}(x)(e)] < \boldsymbol{d}(w)([\![tall]\!])\}$

Then, the information state resulting from the application of *OST* to (11) with respect to the property $[\![tall]\!]$ is (13), which is reproduced here:

(13) $OST(C + \text{"}Only\,John\,is\,tall\text{"}, [\![tall]\!]) = OST((11), [\![tall]\!]) = \{\langle w, \boldsymbol{d}'\rangle\colon \exists \boldsymbol{d}[\langle w, \boldsymbol{d}\rangle \in C \wedge \iota e[[\![tall]\!]^{w,\boldsymbol{d}}(j)(e)] \geq \boldsymbol{d}(w)([\![tall]\!]) \wedge \forall x[x \neq j \rightarrow \iota e[[\![tall]\!]^{w,\boldsymbol{d}}(x)(e)] < \boldsymbol{d}(w)([\![tall]\!])] \wedge \boldsymbol{d}' \geq_{\boldsymbol{w},[\![tall]\!]} \boldsymbol{d}\}$

As (13) is a set of ordered pairs of possible worlds and discourses, in some of which John is not tall, in the others of which John is tall, and in all of which nobody other than John is tall, the following holds:

(17) $OST(C + \text{"}Only\,John\,is\,tall\text{"}, [\![tall]\!])(= (13)) + \text{"}John\,is\,not\,tall\text{"} \neq \emptyset$

That is, $\text{"}John\,is\,not\,tall\text{"}$ is acceptable in $OST(C + \text{"}Only\,John\,is\,tall\text{"}, [\![tall]\!])$, which, according to the definition of the update function for a sentence of the form $might\ \psi$, (15), means the following:

(18) $(13) + might\ \text{"}John\,is\,not\,tall\text{"} = (13)$

Consequently, according to the definition of *acceptance*, the following holds:

(19) $OST(C + \text{"}Only\,John\,is\,tall\text{"}, [\![tall]\!])(= (13)) \Vdash might\ \text{"}John\,is\,not\,tall\text{"}$
($might\ \text{"}John\,is\,not\,tall\text{"}$ is accepted by $OST(C + \text{"}Only\,John\,is\,tall\text{"}, [\![tall]\!]).$)

The result in (19), I contend, models well the felicitousness in continuation observed in (3b). First, $C + \text{"}Only\,John\,is\,tall\text{"}$ represents the speaker's (tentative) assertion that John and nobody else is tall. Second, $OST(C + \text{"}Only\,John\,is\,tall\text{"}, [\![tall]\!])$ corresponds to the state where the speaker has had second thoughts about the standard for the absolute use of the predicate *(be) tall*; she has suspected that the standard might be stricter than she originally assumed. Finally, in the resulting state, it holds that $might\ \text{"}John\,is\,not\,tall\text{"}$ (*maybe, John is not (tall)*), as $OST(C + \text{"}Only\,John\,is\,tall\text{"}, [\![tall]\!]) \Vdash might\ \text{"}John\,is\,not\,tall\text{"}$.

2.5.2. The case of an *only* sentence with a non-vague predicate

In the above, we have seen that the suspension of the prejacent of an *only* sentence with a vague predicate can be modeled well—with the identification of OST for the speaker's second thoughts on the standard for the absolute use of the vague predicate, Veltman's (1996) $might$ for *maybe*, and Veltman's *acceptance* for the felicitousness in continuation with a prejacent-suspending sentence. Now, let us see the case of an *only* sentence with a non-vague predicate, e.g., *Only John is married*.

The information state resulting from updating a given information state C with the utterance of *Only John is married* is analogous to the case of *Only John is tall*, i.e., (11) and as follows:

(20) $C + \text{"}Only\,John\;is\;married\text{"} = C' = \{\langle w, \boldsymbol{d}\rangle \in C: [\![Only\,John\;is\;married]\!]^{w,\boldsymbol{d}} = 1\} = \{\langle w, \boldsymbol{d}\rangle \in C: [\![\,John\;is\;married]\!]^{w,\boldsymbol{d}} = 1 \;\wedge \forall x[x \neq j \rightarrow \iota e[[\![married]\!]^{w,\boldsymbol{d}}(x)(e)] < \boldsymbol{d}(w)([\![married]\!])\} = \{\langle w, \boldsymbol{d}\rangle \in C: \iota e[[\![married]\!]^{w,\boldsymbol{d}}(j)(e)] \geq \boldsymbol{d}(w)([\![married]\!]) \wedge \forall x[x \neq j \rightarrow \iota e[[\![married]\!]^{w,\boldsymbol{d}}(x)(e)] < \boldsymbol{d}(w)([\![married]\!])\}$

The result of applying *OST* to (20) with respect to the property $[\![married]\!]$ will be analogous to (13) and as follows:

(21) $OST(C + \text{"}Only\,John\;is\;married\text{"}, [\![married]\!]) = \{\langle w, \boldsymbol{d}'\rangle: \exists \boldsymbol{d}[\langle w, \boldsymbol{d}\rangle \in C \wedge \iota e[[\![married]\!]^{w,\boldsymbol{d}}(j)(e)] \geq \boldsymbol{d}(w)([\![married]\!]) \wedge \forall x[x \neq j \rightarrow \iota e[[\![married]\!]^{w,\boldsymbol{d}}(x)(e)] < \boldsymbol{d}(w)([\![married]\!])] \wedge \boldsymbol{d}' \geq_{\boldsymbol{w},[\![married]\!]} \boldsymbol{d}\}$

Before proceeding to see the consequences, let me point out a characteristic of non-vague, or definite predicates like *(be) married* with respect to degrees for someone or something to have the denoted property. That is, as a non-vague predicate, there is no vagueness with respect to whether the denoted property is applicable to an object or not. The characteristic is rendered into the following assumption:

(22) Assumption (Binary Degrees for Non-vague Properties)
The possible degrees for something or someone to have the property denoted by a non-vague predicate are binary, e.g., 1 and 0, and the standard for the absolute use of the property is the higher value, in this case, 1.

Given the assumption (22), let us now see if there is any feature with the information state (21) distinct from the information state (13). Indeed, the following holds:

(23) $OST(C + \text{"}Only\,John\;is\;married\text{"}, [\![married]\!]) = \{\langle w, \boldsymbol{d}'\rangle: \exists \boldsymbol{d}[\langle w, \boldsymbol{d}\rangle \in C \wedge \iota e[[\![married]\!]^{w,\boldsymbol{d}}(j)(e)] \geq \boldsymbol{d}(w)([\![married]\!]) \wedge \forall x[x \neq j \rightarrow \iota e[[\![married]\!]^{w,\boldsymbol{d}}(x)(e)] < \boldsymbol{d}(w)([\![married]\!])] \wedge \boldsymbol{d}' \geq_{\boldsymbol{w},[\![married]\!]} \boldsymbol{d}\} = C + \text{"}Only\,John\;is\;married\text{"}$

That is because there are no discourses whose standard for the absolute use of the predicate *(be) married* is higher than those already involved in the information state (10)—with the standard being fixed to the higher degree of the two possible ones in any discourse, as is a consequence of the assumption (22). Consequently, the result of applying OST to $C + \text{"}Only\,John\;is\;married\text{"}$ with respect to $[\![married]\!]$ is the same thing as $C + \text{"}Only\,John\;is\;married\text{"}$; in other words, the operation of *OST* is vacuous when the predicate is a non-vague one. Being identical to $C + \text{"}Only\,John\;is\;married\text{"}$, (23) is a set of ordered pairs of possible worlds and discourses such that in all the ordered pairs, John and nobody else is married, from which the following follows:

(24) $OST(C + \text{"}Only\,John\;is\;married\text{"}, [\![married]\!]) + \text{"}\,John\;is\;not\;married\text{"} = \emptyset$

According to the definition of the relation of *acceptable*, (16), the following holds:

(25) $"John\ is\ not\ married"$ is not acceptable in $OST(C + "Only\ John\ is\ married",$ $[\![married]\!])$.

Thus, according to the definition of the update function of a sentence of the form $might\ \psi$, (14) and that of the relation of *acceptance*, it follows that:

(26) $OST(C + "Only\ John\ is\ married", [\![married]\!]) \not\Vdash might\ "John\ is\ not\ married"$
($might\ "John\ is\ not\ married"$ is not accepted by $OST(C + "Only\ John\ is\ married",$ $[\![married]\!])$.)

The result in (26), I contend, models well the non-suspendability of the prejacent and the infelicity of the continuation observed in (4).

2.5.3. Outcome of the current analysis

As is demonstrated by the two cases above, in the current analysis the following proposition holds:

(27) Proposition:
Let α be a proper noun and P be a predicate.
$OST(C + "Only\ \ \alpha\ P", [\![P]\!]) \Vdash might\ \alpha\ notP$ iff P is a vague predicate.

With the assumptions in (28), the proposition in (27) characterizes well the facts on the suspendability of the prejacent of *only* sentences observed in (3) and (4).

(28) a. What is typographically expressed as "…" in examples of the suspension of the prejacent of an *only* sentence in the literature is a representation of the speaker's second thoughts on the standard for the absolute use of the predicate in question; specifically, she suspects that the standard might be stricter than she originally assumed. And the second thought is analyzed as the OST operator.
b. The epistemic modal that characteristically precedes the sentence suspending the prejacent, i.e., *maybe*, and the felicity in continuation are analyzed as Veltman's (1996) $might$ and *acceptance*, respectively.

2.6. Horn's (2002) notion of *assertoric inertia*: A precursor?

In the current analysis, the suspendability of the prejacent of an *only* sentence is crucially attributed to the vagueness of the predicate and the speaker's afterthought about the standard for the absolute use of the vague predicate. That is, by the utterance of an *only* sentence with a vague predicate, the prejacent is indeed asserted once. However, for some reason, the speaker can suspect that the standard might be stricter than she originally thought and she weakens the original assertion and accepts the possibility that the prejacent is not true.

In fact, in relation to the suspendability of the prejacent of an *only* sentence, Horn (2002) proposed a notion which appears to be related to the current analysis, i.e. *assertoric inertia*. Drawing on Stalnaker's (1978) notion of assertion of an utterance as an agreement among the interlocutors to update the common ground so that it is compatible with the propositional content of the utterance, Horn introduced the notion of assertoric inertia. Something is assertorically inert when it is entailed but not asserted. He proposed that the prejacent of an *only* sentence should be assertorically inert; hence, it should be suspendable. I would like to point out some problems with Horn's analysis. First, he doesn't propose a formal implementation of the very notion of assertoric inertia. Second, he attributes assertoric inertia of the prejacent to *only* sentences as a construction, or the semantics of *only*; consequently, every instance of the prejacent of an *only* sentence would be predicted to be suspendable. However, the prediction is incompatible with the variability of the suspension of the prejacent—the suspendability of the prejacent is subject to whether the main predicate is vague or not among others. As such, Horn's *assertoric inertia*-based analysis can be said to be empirically inadequate.

3. Issues to be addressed

I will conclude this paper by listing some issues to be addressed in the future work:

- In the current work, the cancelability of the prejacent of an only sentence is attributed to the speaker's second thought about the standard for the absolute use of a vague predicate, having nothing to do with the semantics of *only* per se. Hence, it will be predicted that "John is tall … maybe, he isn't" is felicitous. Is this prediction borne out?

- Are there any factors other than vagueness that induce OST? Is OST independently motivated?

- Is there a variant of OST which supposes a more lenient standard instead of a stricter one? If not, why? If there were, the following continuation would be predicted to be felicitous: "Only John is tall …maybe, some other people are".

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Perspectival plurality, relativism, and multiple indexing[1]

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Abstract. In this paper I focus on a recently discussed phenomenon illustrated by sentences containing predicates of taste: the phenomenon of "perspectival plurality", whereby sentences containing two or more predicates of taste have readings according to which each predicate pertains to a different perspective. This phenomenon has been shown to be problematic for (at least certain versions of) relativism. My main aim is to further the discussion by showing that the phenomenon extends to other perspectival expressions than predicates of taste and by proposing a general solution to the problem raised by it on behalf of the relativist. The core claim of the solution ("multiple indexing") is that utterances of sentences containing perspectival expressions should be evaluated with respect to (possibly infinite) sequences of perspective parameters. While such a move sounds radical, I argue that the departure from the traditional Kaplanian framework is not as dramatic as it sounds.

Keywords: perspectival expressions, relativism, perspectival plurality, multiple indexing

It has recently been argued (Kneer, 2015; Kneer, Vicente and Zeman, 2017) that predicates of taste exhibit what these authors call "perspectival plurality": the phenomenon whereby sentences containing two or more such predicates have readings according to which each predicate in the sentence needs to be interpreted relative to a different perspective. In addition, the authors mentioned show that this phenomenon amounts to a serious problem for certain versions of relativism about predicates of taste. Despite the fact that neither the phenomenon itself nor the problem it raises have previously received much attention in literature, perspectival plurality is both interesting in its own right and has important consequences for the semantics of predicates of taste.

In this paper I aim to further the discussion in two directions. First, I want to show that the phenomenon of perspectival plurality is exhibited by more expressions than predicates of taste; second, I want to provide a general solution to the problem the phenomenon poses to relativism. In section 1 I introduce perspectival expressions, discuss their main traits, and sketch how relativism, as opposed to contextualism, treats them. In section 2 I illustrate the phenomenon at stake, starting with predicates of taste and then showing that it extends to other expressions as well. Accessing the relevant readings will require quite a bit of contextual set-up, so I will provide that for each of the examples offered. In section 3 I briefly present the problem perspectival plurality raises for certain versions of relativism, with focus on Lasersohn's view. In section 4 I present the outlines of a relativist solution to the problem,

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consisting in the introduction of sequences of perspectives in the circumstance of evaluation. In the final section I discuss how much of a departure my proposal is from the traditional Kaplanian framework. In the last section I summarize and mention some open questions.

1. Perspectival expressions, contextualism and relativism

If I ask you whether licorice is tasty, you will answer me immediately. Most probably, you will tell me that licorice is tasty or not *from your perspective*, even if talk of perspectives is not explicit in our exchange. Immediacy and implicitness, however, should not obscure the fact that, in answering my question, licorice is deemed tasty or not *with respect to a perspective*: yours. But your perspective is not the only one that can matter: licorice can be deemed tasty or not from another person's perspective – as when, for example, you talk from your child's point of view (such a use of "tasty" has been called "exocentric", in contrast to the first, "autocentric" or "egocentric" use – see Lasersohn (2005) and Stephenson (2007) for discussion). On the other hand, in a context in which it isn't clear which is the perspective that matters, asking whether licorice is tasty should be answered with another question: tasty to whom? All these cases seem to point to the same fact: that, in assessing whether licorice is tasty or not, a perspective needs to be supplied. "Tasty" is, in this sense, *perspectival*.

Expressions like "tasty", "fun", "delicious", "disgusting", "cool" are known as predicates of taste and constitute perhaps the paradigm of perspectival expressions. But they are not the only ones. Aesthetic predicates such as "beautiful", "ugly", etc. belong to this category too. According to some, moral predicates such as "good", "bad" or the moral "ought" are also perspectival in this sense. Furthermore, epistemic modals such as "might", "must" and the like, as well as epistemic terms such as "knowledge", "justification" and co. can be classified in this category too. Granted, the sense of "perspective" relevant for each type of expression is different: in the first case being dependent on a perspective is equivalent with being dependent on a standard of taste, in the second with being dependent on an aesthetic standard – a moral standard, a certain body of knowledge, an epistemic standard, in the other cases. Differences between these are surely important, but in what follows I will use "perspective" as an umbrella-term to refer to whatever it is that the semantic interpretation of the expressions at stake depends on. All the expressions mentioned are, in this sense, perspectival.[2]

Another characteristic of all the expressions mentioned, one that is intimately connected with their perspectivality, is that sentences in which they appear are *context-sensitive* – in the broad sense that utterances of the same sentence can vary in truth value across contexts. To illustrate, let's focus on predicates of taste for the moment. Suppose Johnny and Tony taste licorice for the first time. Johnny loves it, but Tony is repelled by its taste. Assuming that each utter

(1) Licorice is tasty

[2] "Perspective" has been used as a technical term to refer to a specific parameter in the circumstance of evaluation (see below) that is postulated by relativists as part of their semantic machinery (e.g., Kölbel, 2004b). Although I will talk about parameters shortly, at the moment I'm using the term in a neutral, intuitive sense – thus trying to be neutral between various semantic views on the expressions in question. "Perspective" also seems to have another, more self-locating use associated with personal pronouns like "I", adverbs like "here", "now" and "actually" – see footnote 7 for some discussion.

in separate contexts, intuitively Johnny's utterance of (1) is true in his context and Tony's utterance of (1) is false in her context. The truth value of (1) can thus vary with the context in which it is uttered.

Now, in the contemporary debate about the semantics of predicates of taste, relativism has recently become one of the main contenders. Relativism can be best understood in opposition to its main rival, contextualism, so in order to get clear on relativism's semantic commitments I will introduce the two views in tandem. Under one way of seeing the debate, both contextualism and relativism about predicates of taste are attempts to account for the context-sensitivity (in the broad sense illustrated above) of sentences like (1) via the perspectivality of the predicates themselves. In fact, the main difference between the two views can be expressed by saying that they situate perspectivality in different places in the semantic apparatus. Starting from the familiar Kaplanian framework in which the role of context is to provide both elements in the content of utterances *and* values for the parameters in the circumstance of evaluation (Kaplan, 1989: 525), the difference between contextualism and relativism consists in giving precedence to one of those roles of context over the other with respect to perspectives. Thus, for contextualism, the role of context is to provide the perspectives that enter into the semantic content of utterances like (1) above; for relativism, the role of context is to provide the perspectives that enter into the circumstance with respect to utterances like (1) are evaluated. This difference comes out both in *the type of semantic content the two views postulate* (perspective-specific contents for contextualism, perspective-neural contents for relativism) and in *the types of parameters that figure in the circumstance* (possible worlds and perhaps other parameters – but no perspectives – for contextualism; possible worlds and perhaps other parameters *plus* perspectives, for relativism). The same holds with respect to the other perspectival expressions mentioned above, for which the formal representation of the corresponding sentences is similar.[3]

There is a lot of variety within both contextualism and relativism. For example, versions of contextualism can differ by postulating different mechanisms by which context provides the perspectives that enter into the content of the relevant utterances. Thus, perspectives can be provided either as a result of satisfying the character of a perspectival expression (understood as in indexical), or as a result of saturating one or more variables for perspectives that such expressions come endowed with, or by means of unconstrained pragmatic processes of the kind appealed to by truth-conditional pragmatic analyses etc. Versions of relativism can differ by conceiving the context which provides the perspectives that enter into the circumstance differently: it could be either the context of use, as in the Kaplanian framework and more orthodox versions of relativism, or the context of assessment, as more radical

[3] Contextualism about predicates of taste has been upheld by Stojanovic (2007), Glanzberg (2007), Cappelen and Hawthorne (2009), Schaffer (2011); contextualism about moral terms has been proposed by Dreier (1990), among others; contextualism (and relativism) about aesthetic terms is discussed in, e.g., Baker (2012); contextualism about epistemic modals has been defended by, e.g., von Fintel and Gillies (2008) and Schaffer (2011), while contextualism about epistemic terms like "know" has been one of the main contenders for a while now, supported by, e.g., DeRose (1992). On the other hand, relativism about predicates of taste has been defended chiefly by Lasersohn (2005, 2008, 2016) and MacFarlane (2014); relativism about moral terms has been defended by, e.g., Brogaard (2008); Kölbel (2004b) holds relativism about the entire evaluative sphere, including the aesthetic; relativism about epistemic modals is defended in Egan, Hawthorne and Weatherson (2005) and MacFarlane (2014); relativism about epistemic terms has been proposed by, e.g., Kompa (2005), MacFarlane (2014).

versions would have it. Finally, as suggested above, variation in both views can come from *whose* perspective is relevant in all contexts – that of the relevant person (usually the speaker), that of a group to which the speaker belongs to or not, or even a generic perspective. However, for the purposes of this paper most differences between contextualist views, as well as those between relativist views, won't matter and will thus be put aside. The only assumption I make concerns the issue of whose perspective is relevant: namely, that this is a matter that depends on the context. I think flexible versions of both contextualism and relativism are better suited to account for the data.

2. Perspectival plurality

In the preceding section I contended that one of the main and widely agreed upon features of the expressions investigated is their perspectivality: the fact that we appeal to perspectives for their interpretation. This feature, in turn, is responsible for the expressions' sensitivity to context (in the sense described). Recently, however, a related but much less discussed phenomenon involving such expressions has surfaced in the literature: namely, what Kneer (2015) and Kneer, Vicente and Zeman (2017) call "perspectival plurality". Perspectival plurality consists in the existence of certain readings ("plural readings") of sentences containing two or more perspectival expressions that make appeal to more than one perspective. Perspectival plurality has been brought to the fore by the authors mentioned in connection to predicates of taste; here my aim is to show that it is a more general phenomenon, exhibited by (most of) the perspectival expressions mentioned above, as well as by others. The phenomenon is interesting in its own right, but also relevant in connection to relativism about the relevant expressions because, as I will show in section 3, it is highly problematic for at least certain versions of the view.

As it happens, the plural readings that I want to put forward for consideration are not easily available without a certain amount of contextual setting. I will thus provide such a setting before presenting each example. Starting with predicates of taste, imagine the following scenario: Halloween has just passed, and several families from the neighborhood have gathered together to talk about how they spend the holiday. Naturally, at some point the conversation centers on what their kids did, with parents taking turns to tell the stories involving their offspring. Thus, one parent starts describing what his kid did, other parents following suit. When his turn comes, Johnny's father utters

(2) Johnny played a silly prank and had a lot of tasty licorice.

In this context, the most natural interpretation of the sentence seems to be that, while "tasty" pertains to Johnny's perspective, "silly" doesn't (since Johnny himself thought that the prank was great and had a lot of fun playing it); instead, "silly" is most naturally interpreted as pertaining to the father's perspective. This reading of (2) is a combination of an egocentric use of a predicate of taste ("silly") with an exocentric use ("tasty"). Another interpretation of the sentence is that, while "tasty" pertains to Johnny's perspective, "silly" pertains to the perspective of the neighbor, the victim of the prank (to make this reading more palatable, assume, for example, that the victim has previously complained about Johnny's prank). This latter reading of (2) is a combination of two exocentric uses of the two predicates of taste. I take both readings of (2) to show that predicates of taste exhibit perspectival plurality.

Some readers will no doubt find the reading I'm claiming to be available hard, or even impossible, to get. One reason for that might be connected with finding it difficult to interpret "tasty" as pertaining to Johnny's perspective, and not to the father's or the neighbor's. I acknowledge the difficulty, but I think it can be easily alleviated by stipulating that situation is such that i) that the father in fact doesn't like licorice and ii) this is known to everyone in the audience. So the father couldn't use "tasty" egocentrically – that would amount to him saying something false. It seems to me that in such a situation (2) is clearly (and perhaps uniquely) felicitous. And such a situation doesn't strike me as incredibly far-fetched – in fact, I believe many real world scenarios are precisely like it.[4]

In the reminder of this section I will attempt to show that the same happens with other perspectival expressions. Take, for example, aesthetic predicates. Imagine the context to be similar to the one for the interpretation of (2), but that instead of discussing what their kids did on Halloween, the parents are discussing what they did on their school trip to the art museum. The visit comprised both seeing the main exhibition of the museum and a period of playing time in which kids were mostly drawing or painting. As before, one parent starts describing what his kid did, other parents following suit. When her turn comes, Johnny's mother – a sophisticated art lover – utters

(3) Johnny drew a nice portrait of the teacher in the play time and saw an exquisite painting in the main exhibition.

In this context, the most natural interpretation of the sentence is such that, while "nice" pertains to Johnny's perspective, "exquisite" doesn't (since he is too little to have an understanding of good art); instead, "exquisite" is most naturally interpreted as pertaining to the mother's perspective. As the first reading of (2) above, this reading is a combination of an egocentric use of an aesthetic predicate ("exquisite") with an exocentric use ("nice"). Another interpretation of the sentence is that, while "exquisite" pertains to the mother's perspective, "nice" pertains to a third person – say, the art teacher who supervised the kids' playing time (to make this reading more palatable, assume, for example, that Johnny's mother has previously reported the teacher's evaluation of Johnny's drawing). This latter reading of (3) is a combination of two exocentric uses of the two aesthetic predicates. I take both readings of (3) to show that aesthetic predicates exhibit perspectival plurality.

Another type of expressions exhibiting perspectival plurality are moral terms. (4) below seems to easily lend itself to a plural interpretation. Imagine the context to be one on which a student is questioned about her knowledge of various moral theories, by having to respond to particular cases. For easiness, the cases are devised so that to involve (symbolic) characters. Thus, one such case involves Immanuel, a notorious Kantian, and Jeremy, a notorious utilitarian. The question in this particular case revolves around the permissibility of lying. So, asked about what the two characters should do, the student answers with

[4] Two remarks. First, it is important to stress that the claim is *not* that (2) cannot have other readings in other contexts (say, one in which both predicates of taste pertain to the father's perspective) but that, *in the context described above* (with or without making the stipulations mentioned), the plural reading of (2) is the most natural one. Second, in making the case for the availability of the plural readings for (2) I'm not relying solely on my own intuitions: in a series of experiments, Kneer (2015) has shown that for similar sentences plural readings are not only available, but the preferred ones in contexts like the ones devised for (2). For many other examples of plural readings of similar sentences, see also Kneer, Vicente and Zeman (2016).

(4) Jeremy should lie, but Immanuel shouldn't.

In this context, the most natural interpretation of the sentence is such that the first "should" pertains to Jeremy's perspective, while the second "should" to Immanuel's. This is an example in which both moral predicates are used exocentrically, each of them pertaining to a different perspective. I take this reading of (4) to show that moral terms exhibit perspectival plurality.

Sentences containing epistemic modals also seem to admit plural readings. Thus, imagine that Anne and Bob are playing Mastermind. Anne has hidden the pieces and Bob has made his first guess. Immediately after she has given Bob feedback about his guess, Anne departs from the board to get a glass of water. Seeing Bob hold a green piece in his hand and ponder whether to put it on the board or not, Anne comments on his predicament by saying "There might be a green one". Here the "might" pertains to Bob's perspective, since Anne knows very well whether a green piece is among the ones she has hidden or not. But suppose that while she is sure about the green piece, she doesn't remember very well whether a red piece is among the ones hidden too (being away from the board, she cannot currently see it, so she cannot check). She continues the sentence by saying (perhaps only to herself) "and there might be a red one too". This latter "might" doesn't pertain to Bob's perspective as the one before, but to her own instead. Thus, in such a context the most natural interpretation of

(5) There might be a green one, and there might be a red one too,

is such that the first "might" pertains to Bob's perspective and the second "might" to Anne's. The example is thus one in which an exocentic use of an epistemic modal is combined with an egocentric use. Although the scenario is more complex than the ones before, I take this reading of (5) to show that epistemic modals exhibit perspectival plurality.[5,6]

Judging from the examples above, perspectival plurality seems to be a phenomenon exhibited by a wide range of expressions.[7] The reader might not have accessed the relevant readings of

[5] For other examples, as well as for experimental studies involving epistemic modals that show the preponderance of the plural interpretation, see Kneer (2015).
[6] Plural readings of sentences containing epistemic terms like "know" seem harder to come by. One explanation might be based on Lewis' (1996) observation that once a stricter epistemic standard has been made salient in a context, it is hard to go back to a less strict one. This explanation, however, might not work for cases in which the stricter standard is made salient after the less strict one has. Be that as it may, I don't want to rule out that in suitably constructed contexts plural readings of such sentences are possible, but I also won't try to devise a scenario showing that they are here.
[7] On a broader understanding of "perspective", which captures the semantic dependence of sentences on more objective (self-locating) features of the context, such as time, location and possible world, perspectival plurality is manifest with other expressions too. The following sentences seem to allow plural readings:

(i) Anne threw a party and Bob got drunk.
(ii) Every time John visits a city in a foreign country, he goes to all the local bars.
(iii) Claire like more the books she could have written than the books she wrote.

(i) is often given as an example of temporal anaphora, being interpreted such that the interval of Bob's getting drunk is contained in the interval of Anne's throwing of the party; but there is a reading of (i) according to which the events need not overlap (for example, consider (i) as an answer to the question "what did your friends do this weekend/lately?"). One reading of (ii) is that the countries are foreign with respect to John, while the

the sentences provided as *the most natural ones*, as described. This is fine, since the important fact is that the plural readings of the sentences *exist*, even if are not the most natural or default ones. The reader might also be wary to concede that the phenomenon is present in a particular domain or another. This is fine too, since its presence in some domains and absence in others is enough to establish its existence. Thus, even if plural readings are not perceived as the most natural ones, or are limited to certain domains, the examples above show that there is a phenomenon to be taken into consideration.

3. The problem for relativism

Although examples like the above have not been present very much in recent relativist literature, there are a few places where similar examples with plural readings have been discussed.[8] The most comprehensive discussion can be found in Lasersohn (2008). However, Lasersohn doesn't think plural readings are problematic for (his brand of) relativism, because he doesn't think they are available for the sentences he discusses. I will first briefly go through Lasersohn's considerations and then show that he is mistaken.

The context of Lasersohn's discussion is the so-called "argument from binding", made famous by Stanley (2000), and which has prominently figured in the debate between truth-conditional semantics and truth-conditional pragmatics. The argument is used to show that the target expressions have a variable of a certain kind in their syntactic configuration. It is

bars are local with respect to the (denizens of the) cities visited by John. Finally, for the interpretation of (iii), while the reference of the second "books" has to be determined with respect to a possible world in which Claire wrote books (as "could" demands), the reference of the first "books" has to be determined with respect to the actual world (see Creswell (1990) for many more examples like this.) I take these readings of (i)-(iii) to show that perspectival plurality (in the extended sense employed in this footnote) appears with other expressions than the ones focused on in section 2. Interestingly, although utterances of "I" in other languages than English (i.e., Amharic) can in the right environments be used to refer to someone else than the speaker (Schlenker, 2003), plural readings involving two occurrences of "I" in such languages are *not* available (Ninan, 2010). There are, however, examples in which various forms of the first person pronoun refer to different "aspects" of the speaker. For instance, imagine that after a certain outcome of a dice during a board game Mary utters:

(iv) I'm going to move myself two fields ahead.

"I" in (iv) refers to Mary as a person, while "myself" to her representation in the game (say, some token of sorts). This seems to me also like an instantiation of the broad phenomenon under discussion here. Finally, the so-called "de se" interpretations of dream reports (Percus and Sauerland, 2005) seem to fall into this category too. In a sentence like

(v) I dreamt that I was marrying my granddaughter

the second "I" refers to the speaker's dream-self, while "my" to the speaker's real self and thus (v) has, according to the two authors, a plural reading according to which the dream-self of the speaker marries his actual self's granddaughter. Importantly, Percus and Sauerland point out that (v) *cannot* have a plural interpretation according to which the real self of the speaker marries the dream-self's granddaughter. This example opens up further issues related to the scope of the phenomenon, its varieties, its presence in more complex constructions like embeddings under various verbs, as well as to the constraints on the interpretation of sentences that have plural readings. I hope to pursue these questions in further research. I thank an anonymous referee for *SuB21* for bringing dream reports to my attention.

[8] Earlier attempts to criticize relativism by appeal to plural readings of similar (but still importantly different) sentences belong to Cappelen and Hawthorne (2009) and Kissine (2012). See Kneer, Vicente and Zeman (2016) for more details.

both an argument that has been applied to a variety of expressions and against several views. Recently, it has been used against relativism about predicates of taste. To illustrate how it works, consider

(6) Everyone got something tasty. (Schaffer, 2011: 194)

When uttered in a context in which each person from a group of people gets something tasty, (6) has a reading according to which the thing each person got is tasty *from the perspective of that person* – that is, a bound reading. Coupled with the principle that "there is no semantic binding without a syntactically bindable variable", this reading of (6) presumably yields the conclusion that "tasty" has a variable for perspectives in its logical configuration. Given that the presence of such a variable in the logical configuration of "tasty" amounts to a contextualist view, the argument shows that relativism about "tasty" and predicates of taste in general is incorrect.[9]

Lasersohn counters this argument by proposing a different account of binding he dubs "index binding". In essence, index binding replaces the relevant binding in the object language by binding in the meta-language. According to the proposal, quantifiers can bind both variables in the object language and variables in the meta-language. Although he illustrates how this works using meteorological sentences, in the case of (6) the claim would be that the quantifier "everyone" binds both a variable in the object language and one in the meta-language: the first is the subject variable of the verb "get", while the second is the variable for perspectives; the first belongs to the object language, the second to the meta-language. Index binding avoids the conclusion of the argument from binding by avoiding binding of perspectives in the object language altogether, and relegating it to the meta-language instead. Thus, there is no need to postulate variables for perspectives in the object language to account for bounds readings of sentences like (6). Presumably, a similar story can be told for other perspectival expressions for which the argument from binding can (or has) been devised.

Plural readings come in when Lasersohn worries about the expressive power of index binding. He admits from the outset that

> [b]inding the index in this way does not give us the full expressive power of standard variable binding. If, for example, we were to claim that predicates of taste have hidden argument places which can be filled by [variables for perspectives], we should expect to find cases where two of [those variables] both appear free inside the scopes of two different variable-binding operators, each of which binds just one of the [variables]. (Lasersohn, 2008: 325)

To illustrate the worry with an example, consider

[9] For the argument to work against relativism, it has to be assumed that context cannot have both the role of providing elements in the content of a given utterance (in the present case, by providing a value to a variable) *and* that of providing elements into the parameters of circumstance. This claim is encapsulated in the principle Recanati (2007: 34) calls "Distribution" and is assumed by Schaffer and other contextualists mounting the argument.

(7) Every man gave a woman a fun ride and a tasty dish. (Lasersohn, 2008: 325)

If standard variable binding were to apply to (7), it "should have a reading in which the hidden argument for *fun* is bound to *every man*, but the hidden argument for *tasty* is bound by *some woman*" (2005: 325). And, were such a reading available, that would be bad news for index binding. However, Lasersohn further claims,

> [(7)] does not have such a reading. It can be interpreted at least three ways: The speaker might be expressing his or her own opinion that the rides were fun and the dishes were tasty, or claiming that the each man gave a ride that was fun for him and a dish that was tasty for him, or that each woman received a ride that was fun for her and a dish that was fun for her; but *the sentence cannot mean that each man gave some woman a ride that was fun for him, and a dish that was tasty for her*. (2008: 325, my emphasis)

The reading Lasersohn claims (7) cannot have is precisely a plural reading, one in which one predicate is bound by a quantifier (thus pertaining to the perspectives of those in the domain of that quantifier), while the other predicate is bound by another quantifier (thus pertaining to the perspectives of those in the domain of the other quantifier). So, Lasersohn brings in plural readings in connection to sentences like (7) to show that, in fact, they are not available. This, in turn, allows him to put to rest worries related to expressive power, and thus to show that index binding yields the right results when it comes to predicates of taste.[10] Presumably, he would employ the same reasoning in connection to other perspectival expressions.

But, as we show in Kneer, Vicente and Zeman (2017), Lasersohn is too quick to dismiss plural readings. First, although it might be that a plural reading of (7) is unavailable in any context, such a reading seems to be available with similar sentences in certain contexts. To stick with predicates of taste for the moment, take the following example, uttered in the same context as that devised for (2):

(8) Every neighbor let some kids play a silly prank on him and gave them a lot of tasty licorice.

In such a context, the most natural interpretation of (8) is such that, while "tasty" pertains to the perspective of each kid in the range of "some kids", "silly" pertains to that of each neighbor in the range of "every neighbor" (or to that of the speaker). If this is so, then Lasersohn's ban on plural readings of sentences like (7) is not mandated.[11] In the same vein, plural readings seem to be available for similar sentences containing the other expressions mentioned above. To illustrate with aesthetic predicates, uttered in the same context as that devised for (3), the most natural interpretation of

(9) Every teacher showed some kid how to draw a nice portrait of himself and how to appreciate the exquisite paintings in the main exhibition.

[10] He also takes the absence of such readings for (7) to provide an argument against contextualism about predicates of taste. I'm not interested in this aspect here, but see Kneer (2015) for developing this point.
[11] For more similar examples, see Kneer, Vicente and Zeman (2017).

is such that, while "nice" pertains to the perspective of each kid in the range of "some kid", "exquisite" pertains to that of each teacher in the range of "every teacher" (or to that of the speaker). It is of course possible that such readings are not available for all the expressions mentioned, but the availability of such readings for sentences like (8) and (9) clearly shows that Lasersohn's ban on plural readings at least for doubly-quantified sentences containing predicates of taste and aesthetic predicates is empirically incorrect.

Second, as I've shown in section 2, plural readings are clearly available for simple sentences containing the expressions at stake. True, Lasersohn doesn't consider such sentences, so a certain amount of speculation is present here. But assuming that Lasersohn is consistent, his ban on plural readings should extend to simple sentences too. One way to avoid this extension is to claim that the problem stems from the account of binding that he proposes. Although index binding has not been received with a lot of sympathy (see, for example, Snyder (2013) for several objections), this is not the case. As we observe in Kneer, Vicente and Zeman (2017), Lasersohn's ban on plural readings comes from more general considerations having to do with what he takes the commitments of a relativist framework to be. Thus, talking about the absence of plural readings of (7), he writes: "[t]he intuition behind this pattern can perhaps be expressed this way: In a relativist theory, in order to assess a sentence for truth or falsity, one must adopt a stance – that is, *truth assessment is always done from a particular perspective*" (Lasersohn, 2008: 326, my emphasis). Thus, Lasersohn takes this "one sentence – one perspective" principle (what in Kneer, Vicente and Zeman (2017) we call the "Uniqueness of Perspective Constraint") to be at the heart of a (or at least his) relativist theory. The claim is thus completely general and applies to *all* sentences, regardless of their complexity. For Lasersohn, then, plural readings should be banned across the board. Evidently, this doesn't bode well with the data.[12]

4. Towards a solution: multiple indexing

In previous sections I've shown that the phenomenon of perspectival plurality extends beyond predicates of taste (section 2) and, following previous work, that it poses a serious problem for at least certain versions of relativism (section 3). In this section I sketch a possible solution on behalf of the relativist.[13]

As we have seen in section 1, the main feature of relativism is that it introduces a parameter for perspectives in the circumstance of evaluation/index. Now, the problem posed by perspectival plurality shows that one such parameter is not enough. A natural move, then, would be to postulate more than one parameter for perspectives in the circumstance/index. This is an instance of a more general strategy I call "multiple indexing".

[12] The extent to which the "one sentence – one perspective" principle is held in relativist quarters is hard to determine, given that not many relativists have addresses the issue. To my knowledge, Lasersohn is the only one who adheres to it explicitly. Kissine (2012) also seems to think that relativists are committed to it. In any case, I'm happy to contend that the problem raised by perspectival plurality is, at limit, only a problem for Lasersohn's view and for any other relativist view that upholds the principle as a core commitment of the framework.

[13] Due to limitations of space, I'm not able to consider here other possible solutions to the problem. See, however, Kneer, Vicente and Zeman (2017) for a short survey.

Multiple indexing thus consists in the introduction in the circumstance of evaluation/index of more than one parameter *of the same kind*. More precisely, the proposal is that each utterance should be evaluated with respect to *sequences* of such parameters. The idea of a sequence is that it provides an ordering of parameters that are systematically related to the expressions to which they correspond, so that the value of the first parameter of the relevant kind is used to evaluate the first (occurrence of the) expression it corresponds to, the value of the second parameter of the relevant kind is used to evaluate the second (occurrence of the) expression it corresponds to and so on.[14] It is thus a wholesale, global strategy to assess for truth complex sentences by (locally) providing values of the parameters used for the evaluation of each (occurrence of the) expression they correspond to. In our case, the sequence is composed of parameters for *perspectives*, with the result that each parameter will provide a value for the perspective used to evaluate each (occurrence of the) perspectival expression it corresponds to. The strategy helps with perspectival plurality because it allows that, in principle, each (occurrence of a) perspectival expression can be evaluated with respect to a different perspective. This is exactly what cannot happen if one upholds the “one sentence – one perspective” principle considered by Lasersohn to be at relativism’s roots. But it also has no problem with what could be called, in contrast to plural readings, “singular readings”: those that Lasersohn claimed are the only ones available in the case of (7), for example. What happens in such cases is that the values of all the parameters for perspectives are the same – that is, all the perspectival expressions are evaluated with respect to the same value, and, thus, the whole sentence itself.

To illustrate how the strategy is applied, let’s once again focus on predicates of taste and consider the plural reading of (2) made salient in section 2, as well as one of its singular readings – say, the one according to which both “silly” and “tasty” pertain to the speaker’s perspective. Before supplying values for the two parameters for perspectives employed, the template for the truth conditions of (2) looks something like this:

(10) [[Johnny played a silly^1 prank and had a lot of tasty^2 licorice]]$^{c,\ w,\ <p1,\ p2>}$ = 1 iff Johnny played a silly prank in *w* according to the value of *p1* and had a lot of tasty licorice in *w* according to the value of *p2*,

where *p1* and *p2* are the two parameters for perspectives in the sequence introduced, the superscripts on the two predicates of taste represents the order in which they appear and the co-indexing of the parameters with those superscripts signifies that they correspond to the predicates superscripted (*pn* corresponds to Φ^n, where Φ is a predicate). Once values are given to *p1* and *p2*, we obtain the two readings of (2) mentioned above. Thus, the plural reading is represented as follows:

(11) [[Johnny played a silly^1 prank and had a lot of tasty^2 licorice]]$^{c,\ w,\ <p1[speaker],\ p2[Johnny]>}$ = 1 iff Johnny played a silly prank in *w* according to the speaker’s perspective and had a lot of tasty licorice in *w* according to Johnny’s perspective,

[14] In other words, we define a kind of assignment function (similar to that defined in. e.g., Heim and Kratzer (1998), but on the circumstance side, as it were) that assigns to each occurrence of a perspectival expression the corresponding perspective parameter in the sequence.

where *pn[v]* should be read as "*v*'s perspective is the value of the *pn*-th parameter for perspectives", so that the value of *p1[speaker]* is the speaker's perspective and the value of *p2[Johnny]* is Johnny's perspective.[15] The singular reading of (2) mentioned above is represented as follows:

(12) [[Johnny played a silly^1 prank and had a lot of tasty^2 licorice]]$^{c,\ w,\ \langle p1[speaker],\ p2[speaker]\rangle}$ = 1 iff Johnny played a silly prank in *w* according to the speaker's perspective and had a lot of tasty licorice in *w* according to the speaker's perspective.

The difference in readings is simply the result of giving different values to the sequence of perspectives in the circumstance/index. The framework is flexible enough to capture all the possible plural readings, but also all the possible singular readings of sentences like (2), as well as those of similar sentences comprising the other expressions mentioned.[16]

Now, in representing the abstract truth-conditions of (2) I have used a sequence of perspective parameters with only two elements for convenience. But given the existence – at least in principle – of sentences with an infinite number of perspectival expressions that might admit of plural readings, the two parameters are not enough. So the sequences I propose to introduce will have to be infinite as well. From a formal point of view, this poses no significant problem. Vlach (1973), as well as Cresswell (1990), discuss the possibility of adopting systems with infinite indexing, and the reasons they offer are very similar to whose presented in this paper (namely, the need to account for plural readings of sentences containing perspectival expressions, in the broader sense of "perspective" mentioned in footnote 7). Alternatively, one could employ a finite but non-limited sequence of perspective parameters, on the model of Vlach's system with times (Vlach, 1973, Appendix)). Certain authors (e.g., Rabern, 2012) show that a non-finite number of parameters is in fact *necessary* for semantics. Be that as it may, the point here is that although I have used a sequence with only two perspective parameters, there is no obstacle to using one with infinite parameters. In such a case, every sentence will be relative to an infinite sequence, but the majority of parameters will be idle, since in fact sentences with an infinite number of perspectival expressions will not be uttered. (The idleness of certain parameters is a move already familiar to the relativist, given that there are sentences that don't contain any perspectival expressions; see Kölbel (2009) for this point.) There is an alternative route, too: instead of taking semantic values to be functions from infinite sequences to truth-values, one can see them as *partial functions* from sequences with a number of parameters *n* to truth values, where the partial functions are obtained by imposing the condition that *n* is the same as the number of perspectival expressions in the sentence whose semantic value is evaluated for truth.[17]

[15] The representation of the reading of (2) according to which "silly" pertains to the perspective of the neighbor, the victim of the prank, is obtained by replacing the first parameter in the sequence, *p1[speaker]*, with *p1[neighbor]*.

[16] An important question that can be asked at this point is how exactly are the values of the parameters for perspectives determined in a certain context. I cannot provide a detailed answer here, but the short one is: at least partially, *by the intentions of the speaker*. This has a certain "pragmatic" ring to it; I happily accept that. Providing values for parameters of circumstance has been deemed by several authors (including relativists: see MacFarlane's (2014) "post-semantics") as a pragmatic phenomenon.

[17] I'm indebted to David Rey for discussion and suggestions on this point.

As for plural readings of complex sentences with quantifiers like (8), I think there is more than one way to go, depending on the account of binding adopted. One option would be to keep Lasersohn's index binding[18], but give up the "one sentence – one perspective" principle that comes with it and allowing a quantifier phrase to bind *only* the *n*-th parameter for perspectives in the sequence, namely that corresponding to the *n*-th predicate in the sentence. Alternatively, the relativist could adopt the view put forward in Zeman (2015), according to which quantifier phrases like "every neighbor" contribute a "for *x*" phrase that is construed as a variadic operator of the kind proposed by Recanati (2002). Variadic operators are extensional operators that transform a predicate into another predicate with higher adicity, whose additional argument in a sentence like (8) gets bound by "every neighbor". Deciding which of these two alternatives ultimately serves best the relativist is no doubt important, but for the purposes of this paper such a decision need not be made. In principle, the multiple indexing strategy is independent of the account of binding adopted. To keep things simpler, however, I will illustrate how sentences like (8) are treated by using index binding. This time I will give the truth conditions for three readings of (8), the plural one made salient in section 3 and two singular ones, one in which both "silly" and "tasty" pertain to the speaker's perspective, the other in which they pertain to the range of neighbors quantified over by "every neighbor" (this latter case corresponding to both predicates of taste being bound by the quantifier phrase). Before supplying values for the two parameters for perspectives employed, the template for the truth conditions of (8) is (simplifying greatly)

(13) [[Every neighbor let some kids play a silly^1 prank on him and gave them a lot of tasty^2 licorice]]$^{c,\, w,\, <p1,\, p2>}$ = 1 iff Every neighbor *x* let some kid *y* play a silly prank on *x* in *w* according to the value of *p1* and *x* gave *y* a lot of tasty licorice in *w* according to the value of *p2*.

Once values are given to *p1* and *p2*, we obtain the three readings of (8) mentioned above. Thus, the plural reading is represented as follows:

(14) [[Every neighbor let some kids play a silly^1 prank on him and gave them a lot of tasty^2 licorice]]$^{c,\, w,\, <p1[x],\, p2[y]>}$ = 1 iff Every neighbor *x* let some kid *y* play a silly prank on *x* in *w* according to *x*'s perspective and *x* gave *y* a lot of tasty licorice in *w* according to *y*'s perspective,

where "every neighbor" and "some kids" quantify both over object language variables and over parameters for perspectives in the index, as Lasersohn's index binding requires, with each of them quantifying over one of the parameters in the sequence (the former over *p1*, the latter over *p2*).[19] The two singular readings mentioned above are represented by (15) and (16), respectively:

(15) [[Every neighbor let some kids play a silly^1 prank on him and gave them a lot of tasty^2 licorice]]$^{c,\, w,\, <p1[x],\, p[x]>}$ = 1 iff Every neighbor *x* let some kid *y* play a silly prank on *x* in *w* according to *x*'s perspective and *x* gave *y* a lot of tasty licorice in *w* according to *x*'s perspective.

[18] Assuming the problems that beset it (Snyder, 2013) are solved.
[19] The representation of the plural reading of (8) according to which "silly" pertains to the perspective of the speaker is obtained by replacing the first parameter in the sequence, *p1[x]*, with *p1[speaker]*.

(16) [[Every neighbor let some kids play a silly^1 prank on him and gave them a lot of tasty^2 licorice]]$^{c,\ w,\ \langle p1[speaker],\ p2[speaker]\rangle}$ = 1 iff Every neighbor *x* let some kid *y* play a silly prank on *x* in *w* according to the speaker's perspective and *x* gave *y* a lot of tasty licorice in *w* according to the speaker's perspective.

As before, the difference in readings is simply the result of giving different values to the sequence of perspectives in the circumstance/index. The framework is flexible enough to capture all the possible plural readings, but also all the possible singular readings of sentences like (8), as well as those of similar sentences comprising the other expressions mentioned.

5. How unorthodox is multiple indexing?

Naturally, the framework just put forward is liable to a number of objections. For reasons of space, I will address here perhaps the most obvious one: that it is highly unorthodox, in that it departs significantly from the Kaplanian framework in which the debate between relativism and contextualism has been, so far at least, framed. I will try to show that, while it is indeed a departure from the Kaplanian view, the departure is not dramatic.

One source for the feeling of oddness might be the very idea of countenancing *more than one parameters of the same kind* in one's semantic framework. However, this worry is easy to assuage. The Kaplanian framework in which the debate between contextualism and relativism has been cast (and which I take here to be the orthodox view[20]) *already* makes appeal to more than one contextual element of the same kind in the semantic apparatus. For Kaplan (1989), but also for Lewis (1980), many contextual elements are part both of the context of utterance (understood here in a formal sense as a tuple of contextual features – agent, time, location, world) *and* of the circumstance/index (world and time for Kaplan; world, time, location and standards of precision for Lewis). But the need to introduce more than one contextual element of the same kind has been noted even before that: as Kamp (1971), Vlach (1973) and others have shown (in the particular case of time), this is needed for the interpretation of complex sentences in natural language, like "One day, all persons alive now will be dead". The novelty brought by Kaplan and Lewis was to show that we need to distinguish clearly (on pain of conflating the logically valid with the necessary) between two roles such contextual features play: on one hand, we need them to fix the content of utterances ("context"); on the other, we need them to allow that such content is evaluated at different situations ("circumstance of evaluation"/"index"); no semantic theory is complete without one or the other. So, far from being objectionable, the introduction of two contextual elements of the same kind is, according to Kaplan and Lewis, a requirement for an adequate semantic theory.

Perhaps then one might think that multiple indexing is unorthodox because one might find the idea of introducing more than one parameter of the same kind in *any* side of the context-circumstance/index division odd. This worry is put to rest by attending to the fact that in the Kaplanian framework itself we need to postulate more than one contextual element of the same kind in the context (understood now formally as a tuple of elements, "context"). As

[20] "Unorthodox" views that depart from the Kaplanian framework are not uncommon: for a recent view that reminds one of the old, pre-Kaplanian "index theory" of Lewis (1970), see Stojanovic (2012).

widely known, the focus of Kaplan's main work has been both on what he called "pure indexicals" and on demonstratives. When it comes to the latter, an element that gives the content of a demonstrative has to be introduced in the (formal) context, in the same way in which the speaker has been introduced in order to give the content of a pure indexical like "I". So, besides agent, time, location and possible world, the Kaplanian formal notion of context includes a demonstration[21] that would give the content of the demonstrative in a sentence like "That is a boat". But this cannot be the end of the story, since there are sentences containing two or more demonstratives, such as

(17) That is on top of that,

where the first "that" is accompanied by a demonstration targeting one object and the second "that" by a demonstration targeting another object. In order for (17) to get a content, context has to provide not only one demonstration, but two. That is, we need two elements for demonstrations in the Kaplanian (formal) context. And, given that there are sentences with more than two demonstratives ("That is between that and that"), things are not likely to stop here.

So, then, the remaining source of resistance to multiple indexing is that one finds the idea of introducing more than one parameter of the same kind *in the circumstance/index* side of the aforementioned division itself odd. While this is far from an argument, it pushes the question of the motivations for doing so. Of course, the main claim of this paper is that perspectival plurality is precisely such a motivation. But it is important to note that, in the end, perspectival plurality does very little on top of other arguments for relativism to embrace multiple indexing. In other words, any reason the relativist has to introduce *one* parameter of a certain kind in the circumstance/index can automatically be turned into a reason to introduce *more than one* such parameter by attending to perspectival plurality.

So, what about the actual arguments for introducing one parameter of a certain kind in the circumstance/index? To keep it close to orthodoxy, let's consider Kaplan and Lewis' main reason for drawing the distinction between context and circumstance/index in the first place: namely, the need to separate contextual elements that are *shiftable* from those that are not. Their reasoning was the following: if a contextual element is shiftable, then it becomes part of the circumstance/index; if it's not, then it becomes part of the context. To exemplify, the contextual element that gives the content of a pure indexical like "I" (the speaker) is considered not to be shiftable (in English, anyway). This is usually put by saying that "I" "scopes out" from under various embeddings and always refers to the speaker. However, no such "scoping out" seems to happen in the examples containing perspectival expressions considered in this paper.[22] If anything, perspectives can easily be shifted (the perspective to which "tasty" pertains to in "Licorice is tasty for Johnny" is clearly Johnny's) – and, if

[21] Or a demonstrative intention. On this matter, Kaplan has changed his mind from "Demonstratives" to "Afterthoughts". I myself don't commit to any of these views; I mention demonstrations only to get my point across.

[22] This point is also made in Kneer, Vicente and Zeman (2017). The conclusion drawn there, however, is that multiple indexing is not viable, because the examples dealt with don't contain "reference-fixing expressions" like "now" in Kamp/Vlach sentences. This a mistake: what such considerations show is at best that a *certain* form of multiple indexing is not viable, one that is different from the present proposal. See the argument below.

perspectival plurality is a real phenomenon, such shifting can take place in more than one direction (a claim that can be further illustrated by making all the perspectives explicit, as in "Licorice is tasty for Johnny, but not tasty for Tony"). So, if one accepts a Kaplan/Lewis-style argument from shiftability to the introduction of parameters for perspectives in the circumstance/index, then perspectival plurality as illustrated in this paper justifies the further step of introducing more than one such parameter – in a way that is entirely coherent with the Kaplanian framework.[23]

Of course, not everyone accepts the argument from shiftabilty (a.k.a. "the operator argument"), for various reasons. Many authors have questioned its premises, based on considerations having to with the correct syntactic representation of the sentences at stake (see King (2003), among many others). What's more, even if the premises at stake are accepted, both their necessity (MacFarlane, 2009) and their sufficiency (Ninan, 2010) for the desired conclusion have been denied. However, the good news for the multiple indexing relativist is that she doesn't need to rely (and some relativists have explicitly advised against doing so – e.g., MacFarlane (2009)) on this argument. A variety of other motivations for relativism have been given in the literature, from phenomena like "faultless disagreement" (Kölbel, 2004a; Lasersohn, 2005, 2008, 2016), eavesdropping (Egan, Hawthorne and Weatherson, 2005), retraction (MacFarlane, 2014) to arguments of a syntactic nature (Lasersohn, 2009). Some of those arguments might move the reader more than others; discussing their efficacy has not been my purpose here. But the point made above remains: assuming one *already* has arguments, of whatever kind, for the introduction of a certain parameter in the circumstance/index, the phenomenon of perspectival plurality gives one a sufficient reason to introduce more than one such parameter. And given that none of the arguments mentioned is incompatible with the Kaplanian framework, if what I've said in this section is on the right track, then multiple indexing is not such a drastic departure from the Kaplanian orthodoxy as one might have initially thought.

6. Summary and open questions

I started this paper by focusing on a recently discussed phenomenon illustrated by sentences containing predicates of taste: perspectival plurality. I then showed, following previous work, that this phenomenon creates problems for at least certain versions of relativism. My main aim in the paper was to further the discussion by showing that the phenomenon extends to other perspectival expressions than predicates of taste and by proposing a general solution to the problem raised by it on behalf of the relativist. The core claim of the solution is that utterances of sentences containing perspectival expressions should be evaluated with respect to (possibly infinite) sequences of perspective parameters (that is, multiple indexing). This solution helps with perspectival plurality because, in principle, it allows each (occurrence of a) perspectival expression to be interpreted as pertaining to a different perspective. In the previous section I marshaled some considerations against seeing multiple indexing as a radical departure from the traditional Kaplanian framework.

Now, what I offered here is a mere sketch, rather than a full-fledged theory. But one gets a clear idea of the work to be further done. First, a more precise formalization of the apparatus is required. Second, shielding the view from more objections is crucial. Third, a thorough

[23] I'm indebted to Adrian Briciu for discussion of these intricate issues.

comparison with other possible solutions to the problem posed by perspectival plurality needs to be undertaken. Fourth, the implications for semantics in general and for the debate between contextualism and relativism will need to be made clear. For example, one important question is what type of semantic content we end up countenancing if we adopt such a view, so that to be able to tell what does it mean to assert, have attitudes and communicate such contents. This has obvious consequences for the debate between contextualism and relativism, on which I did not focus here. A key issue to be dealt with in this connection is to ascertain what readings of sentences containing perspectival expressions are allowed and which are not, and see which of the two views best account for the whole range of data. Admittedly, I have here only scratched the surface; progress will be made by a full investigation of the limits and constraints of perspectival plurality. These are all open question that the multiple indexing relativist will need to address.

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Modified numerals revisited: The cases of *fewer than 4* and *between 4 and 8*[1]

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Abstract. There seems an interplay between (i) the interpretation of sentences containing non-increasing modified numerals (e.g., *fewer than 4*, *between 4 and 8*) and (ii) the type of predicates in those sentences. For example, (i) *fewer than 4 boys smiled*, where the predicate is distributive, has no existential entailment, but an upper-bound reading; while (ii) *fewer than 4 boys lifted the piano together*, where the predicate is collective, has an existential entailment, but no upper-bound reading. Following Brasoveanu (2013)'s post-supposition-style account for modified numerals, here I propose that (I) the semantic contribution of non-increasing modified numerals is twofold: (i) introducing a maximal referent as at-issue meaning in the derivation, and (ii) adding a cardinality constraint as a secondary dimension of meaning, and that (II) it is the type of predicates (distributive vs. collective) that determines the scope of maximization and where to evaluate this secondary dimension of meaning – at the sentential level or within a group-denoting DP.

Keywords: modified numerals, distributivity, collectivity, maximality, post-supposition.

1. Introduction

The semantics of **non-increasing modified numerals** has been a hot topic in current formal linguistic research. It has been noticed for decades that there seems an interplay between the interpretation of sentences containing this kind of modified numerals and the type of predicates therein.

As illustrated in (1), when a **downward-entailing (DE)** modified numeral (here *fewer than 4*) combines with a **distributive** predicate (here *smile*), the sentence has an upper-bound reading, but no existential entailment. I.e., sentence (1) is compatible with a situation in which no boys smiled. In contrast, as illustrated in (2), when *fewer than 4* combines with a **collective** predicate (here *lift the piano together*), the sentence has an existential entailment. I.e., if there were no boys at all involved in piano-lifting, sentence (2) is judged infelicitous according to our intuition. However, if there were two groups, one of 3 boys and the other of 8 boys, and each group collectively lifted the piano, sentence (2) is true and felicitous in this scenario – it simply means that a certain group of fewer than 4 boys collectively lifted the piano. I.e., there is no upper-bound reading for sentence (2): it does not rule out the possibility of more boys involved in piano-lifting.

(1) Fewer than 4 boys smiled. *smile*: **distributive** predicate
  a. ✓**Upper-bound reading**: ruling out the possibility of more boys smiling.
  b. # **Existential entailment**: asserting the existence of smiling boys.

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(2) Fewer than 4 boys lifted the piano together. *lift the piano together*: **collective** predicate
  a. # **Upper-bound reading**: ruling out the possibility of more boys involved in piano-lifting.
  b. ✓**Existential entailment**: asserting the existence of piano-lifting boys.

Thus (3) summarizes the basic empirical observations with regard to interpreting sentences containing DE modified numerals. This pattern was initially noted in Winter's work (see, e.g., Winter 2001; Ben-Avi and Winter 2003) and much studied recently by Buccola and Spector (see Spector 2014; Buccola 2015a, b; Buccola and Spector 2016; Buccola 2016). As noted in these works, the generalization in (3) can also be extended to the cases of **non-monotone** modified numerals, such as *between 4 and 8* (see (4), except that here there is always an existential entailment).

(3) Generalization on interpreting sentences containing DE modified numerals:[2]

	Distributive predicate	**Collective predicate**
Upper-bound reading	✓	#
Existential entailment	#	✓

(4) *Between 4 and 8* + **distributive / collective** predicates:
  a. Between 4 and 8 boys smiled. ✓ Upper-bound reading
  b. Between 4 and 8 boys lifted the piano together. # Upper-bound reading

To account for the pattern shown in (3), Buccola and Spector have proposed an 'over-generation + pragmatic blocking' approach, which, I argue, suffers from empirical and conceptual problems. In this paper, by following Brasoveanu (2013)'s post-supposition-style approach, which was originally developed to analyze the cumulative reading of sentences containing *exactly*-type modified numerals (e.g., *exactly three boys saw exactly five movies*), I propose a purely semantic account that generates exactly the attested readings summarized in (3). In a nutshell, I propose that **(I)** the semantic contribution of non-increasing modified numerals is twofold: (i) introducing a maximal referent as **at-issue meaning** in the derivation, and (ii) adding a cardinality constraint as a **secondary dimension of meaning**, and that **(II)** it is the type of predicates (distributive vs. collective) that determines the scope of maximization and where to evaluate this secondary dimension of meaning – at the sentential level or within a group-denoting DP.

Section 2 presents Buccola and Spector (2016)'s 'over-generation + pragmatic blocking' approach that is based on the notion of number-based maximality, and I discuss empirical and conceptual challenges to it. Based on Brasoveanu (2013)'s study, my new account is presented in Section 3. Section 4 discusses cumulative readings. Section 5 discusses another approach developed in Buccola and Spector (2016), which is based on the notion of informativity-based maximality. Section 6 compares the current account with the main idea of Solt (2006). Section 7 concludes the paper.

[2]The lack of existential entailment for distributive-reading sentences with DE quantifiers has also been called *Van Benthem's problem* (see Van Benthem 1986).

2. Buccola and Spector (2016)'s 'over-generation + pragmatic blocking' approach

Buccola and Spector (2016) have presented and discussed four specific accounts, each involving some notion of **maximality**. Overall, all these accounts are based on the idea of 'over-generation + pragmatic blocking'. They differ along two parameters: (i) the **type** of maximality (number-based vs. informativity-based) and (ii) the **source** of maximality (lexically encoded vs. non-lexical). In this section, I focus on the two accounts using a number-based maximality operator, and those using an informativity-based maximality operator will be discussed in Section 5.

2.1. Buccola and Spector (2016): Number-based maximality operator + pragmatic blocking rule

The basic idea of this approach includes two parts. First, in natural language semantics, there is a maximality operator max of type $\langle dt, d\rangle$ involved in the interpretation of modified numerals. Crucially, there is scope interaction between this operator max and existential closure $\exists$, leading to potential ambiguity, i.e., over-generating sentence readings. Second, there is a pragmatic rule, which rules out any readings in which the semantic contribution of a numeral n is trivial.

(5) shows the definition of the number-based maximality operator max in Buccola and Spector (2016). Essentially, max takes a totally ordered set P (of type $\langle dt\rangle$ – d stands for *degree*, an element in a totally ordered set) as input and returns its upper bound n (of type d) as output. In Buccola and Spector (2016), inputs of max are almost always convex sets of natural numbers.[3] To avoid any potential existential entailment problems, Buccola and Spector (2016) assume that an empty set can also serve as the input of max, and in this case, the output is simply 0.[4]

(5) Number-based maximality operator: max Buccola and Spector (2016)

$$[\![\mathsf{max}(P_{\langle dt\rangle})]\!] = \begin{cases} \iota n.P(n) \wedge \forall m[P(m) \rightarrow m \leq n] & \text{if } \exists n P(n) \\ 0 & \text{otherwise} \end{cases}$$

Buccola and Spector (2016) provide two ways to implement max: **L(exical)Max** and **SMax**.[5] As (6) shows, within the analysis of LMax, max is part of the lexical semantics of *fewer than*. *Fewer than* takes a number n (of type d) as input and returns a generalized quantifier over

[3] Briefly speaking, a **convex** totally ordered set is a totally ordered set P such that for any elements a and b in the set, if $a \leq b$, then any element x such that $a \leq x \leq b$ is also in the set. E.g., $\{x|x > 0\}$, $\{x|x < 4\}$, and $\{x|4 \leq x < 8\}$ are all convex sets, while sets such as $\{x|x \leq 5 \vee x > 8\}$ are not convex.

[4] Notice that if a set has no upper bound (e.g., $\{x|x \geq 0\}$, which has an infinite endpoint) or the upper bound is open (e.g., $\{x|0 \leq x < 5\}$, in which the endpoint 5 is not included), then for any number x in the set, there is aways another number y such that (i) $y > x$ and (ii) y is also in the set. Thus this kind of sets are undefined in Buccola and Spector (2016)'s max. In a footnote, Buccola and Spector (2016) mention the maximality failure issue for sentences such as *fewer than 5 prime numbers are odd*, which is intuitively judged false, not undefined, but according to their analysis, the set of numbers $\lambda n.[\exists x.|x| = n \wedge \textsc{prime-number}(x) \wedge \textsc{odd}(x)]$ is undefined for their max in (5). This issue is left unsolved in their paper, but it does not arise with the analysis proposed in this paper (see Footnote 10).

[5] According to Buccola and Spector (2016), SMax can be understood as either SyntacticMax or SeparateMax.

degrees (i.e., something of type $\langle dt, t\rangle$) as output.[6] Since [[fewer than n]] is analyzed as a generalized quantifier, there can be scope interaction between [[fewer than n]] and existential closure $\exists$ in deriving sentence meanings. (7) shows the derivation of two (potential) readings for the sentence *fewer than 4 boys smiled*. In (7a), *fewer than 4* raises to a position that takes scope over the rest of the sentence. Since max takes wider scope over the existential closure and it can potentially return 0 as output, the interpretation thus derived has no existential entailment. In contrast, in (7b), *fewer than 4* raises to a position that is still inside of the scope of existential closure (actually inside of AP), thus the wide scope of existential closure guarantees the existential entailment. Since *smile* is a distributive predicate (see (8a)), the semantic contribution of *fewer than 4* in (7b) is in effect vacuous.

(6) The implementation of maximality in **LMax**:
$[\![\text{fewer than}]\!]_{\langle d,\langle dt,t\rangle\rangle} \overset{\text{def}}{=} \lambda n_d.\lambda P_{\langle dt\rangle}.[\mathsf{max}(P) < n]$

(7) Using LMax to derive [[fewer than 4 boys smiled]]:
a. [[fewer than 4]] takes wider scope over $\exists$: $\rightsquigarrow$ Upper-bound reading
$[\text{fewer than } 4][\lambda n.[\exists[n \text{ boys smiled}]]]$
$\Leftrightarrow \mathsf{max}([\lambda n.[\exists x[|x| = n \wedge \textsc{boys}(x) \wedge \textsc{smile}(x)]]) < 4$
i.e., the maximal value that is equal to the cardinality of smiling boys is less than 4.
b. $\exists$ takes wider scope over [[fewer than 4]]: $\rightsquigarrow$ Existential entailment
$[\exists[\lambda x.[[\text{fewer than } 4][\lambda n.|x| = n]]]\text{boys}]\text{smiled}$
$\Leftrightarrow \exists x[\mathsf{max}(\lambda n.|x| = n) < 4 \wedge \textsc{boys}(x) \wedge \textsc{smile}(x)]$
$\equiv \exists x[|x| < 4 \wedge \textsc{boys}(x) \wedge \textsc{smile}(x)]$ (see (8a))
$\equiv \exists x[\textsc{boys}(x) \wedge \textsc{smile}(x)]$ i.e., there are smiling boys. $\rightsquigarrow$ No upper-bound reading

(8) **Distributivity**: P is distributive iff $\forall x, y[P(x) \wedge y \leq_{\text{part}} x \rightarrow P(y)]$.
a. ✓*Smile*: if a group of boys smiled, it follows that each boy smiled.
b. # *Lift the piano together*: if a group of boys collectively lifted the piano, it doesn't follow that a subset of these boys formed a group and lifted the piano together.

The unattested reading shown in (7b) means that insofar as there are smiling boys, there always exists a subset of smiling boys whose cardinality is less than 4. I.e., the numeral 4 can be replaced by any other numerals without affecting the truth condition of this reading. Thus, Buccola and Spector (2016) propose the pragmatic constraint (9) to rule out the reading in (7b).

(9) Buccola and Spector (2016)'s pragmatic economy constraint:
An LF ϕ containing a numeral n is infelicitous if, for some m distinct from n, ϕ is truth-conditionally equivalent to $\phi[n \mapsto m]$ (the result of substituting m for n in ϕ).

Similar to (7), (10) illustrates the derivation of two readings for a sentence containing collective

[6] The definition in (6) is slightly different from the one given in Buccola and Spector (2016), which is like this: $[\![\text{fewer than}]\!]_{\langle d,\langle dt,t\rangle\rangle} \overset{\text{def}}{=} \lambda n_d.\lambda P_{\langle dt\rangle}.\exists m[m < n \wedge \mathsf{max}(P) = m]$. I.e., in their original definition, there is also an existential closure, the semantic contribution of which is actually vacuous and not motivated in their paper.

predicates. In (10b), since *lift the piano together* is a collective predicate, obviously, if fewer than 4 boys formed a group and lifted the piano together, it doesn't follow that a subset of these boys also formed a group to lift the piano together (see (8b)). Thus, the semantic contribution of *fewer than 4* in (10b) is not trivial, and there is no need to apply the pragmatic rule in (9). In this analysis, (10b) naturally has an existential entailment, but no upper-bound reading. The derivation in (10a) essentially leads to the unattested reading that no groups of boys with a cardinality equal to or larger than 4 lifted the piano together, but in Buccola and Spector (2016), the accounts of LMax and SMax do not include a mechanism to block this unattested reading.

(10) Using LMax to derive [[fewer than 4 boys lifted the piano together]]:

a. [[fewer than 4]] takes wider scope over $\exists$: $\rightsquigarrow$ Upper-bound reading
[fewer than 4][λn.[$\exists$[n boys lifted the piano together]]]
$\Leftrightarrow \mathsf{max}([\lambda n.[\exists x[|x| = n \wedge \textsc{boys}(x) \wedge \textsc{lift-the-piano-together}(x)]) < 4$
i.e., the max. value that is equal to the cardinality of piano-lifting boys is less than 4.

b. $\exists$ takes wider scope over [[fewer than 4]]: $\rightsquigarrow$ Existential entailment
[$\exists$[λx.[[fewer than 4][$\lambda n.|x| = n$]]]boys]lifted the piano together
$\Leftrightarrow \exists x[\mathsf{max}(\lambda n.|x| = n) < 4 \wedge \textsc{boys}(x) \wedge \textsc{lift-the-piano-together}(x)]$
$\equiv \exists x[|x| < 4 \wedge \textsc{boys}(x) \wedge \textsc{lift-the-piano-together}(x)]$ (see (8b))
$\not\equiv \exists x[\textsc{boys}(x) \wedge \textsc{lift-the-piano-together}(x)]$

In the account of SMax, the maximality operator max is independent of the lexical semantics of modified numerals, and the use of max is rather optional. Consequently, the scope of max – depending on the landing site of *fewer than n* in quantifier raising – can be flexible. Thus, all the readings shown in (7) and (10) can be generated, and the pragmatic rule (9) is needed to block the unattested 'existential entailment' reading shown in (7b). Moreover, since max is optional, when it is not applied, as shown in (12), the effect is equivalent to $\exists$ taking wide scope over max.

(11) **SMax** – max is not contained in the lexical semantics of *fewer than*: (cf. (6))
[[fewer than]]$_{\langle d,\langle dt,t\rangle\rangle} \overset{\text{def}}{=} \lambda n_d.\lambda P_{\langle dt\rangle}.\exists m[m < n \wedge P(m)]$

(12) SMax: when max is not applied:

a. [[fewer than 4 boys smiled]] $= \exists x[|x| < 4 \wedge \textsc{boys}(x) \wedge \textsc{smile}(x)]$ = (7b)

b. [[fewer than 4 boys lifted the piano together]]
$= \exists x[|x| < 4 \wedge \textsc{boys}(x) \wedge \textsc{lift-the-piano-together}(x)]$ = (10b)

Buccola (2016) points out that due to the extra flexibility in using max, SMax is superior to LMax in analyzing the generic reading of the sentence *fewer than 4 boys can together lift that piano*. As shown in (13), under this **generic** reading, the sentence means that for a certain number n, in general, n boys can collectively lift that piano, and this number n is smaller than 4. Crucially, this reading can be naturally derived via SMax, with no use of max. However, since max is a necessary part in the semantics of *fewer than* in LMax, LMax fails to generate this reading.

(13) The **generic** reading of *fewer than 4 boys can together lift that piano*:
$\exists n[n < 4 \wedge \forall_{\text{GEN}} x[|x| = n \wedge \textsc{boys}(x) \rightarrow \diamond\textsc{together-lift-that-piano}(x)]]$
(Context: Al asks: 'How many boys do we need to lift that piano?' Then Bill answers: 'Well, I'm not sure. But I believe fewer than 4 boys can together lift that piano.')

To sum up, Buccola and Spector (2016) propose to use a maximality operator that is applied to sets of **numbers**, and the use of this maximality operator helps create ambiguity (via scope interaction and/or optionality). Their pragmatic rule helps to block some of the over-generated readings.

2.2. Challenges to the approach of Buccola and Spector (2016)

Here I present empirical and conceptual challenges to these two accounts LMax and SMax. First of all, as already mentioned, both LMax and SMax generate an unattested upper-bound reading for sentences containing collective predicates (see (10a)), and their pragmatic constraint (9) is not applicable in this case to rule out this reading. Similarly, the sentence shown in (13) has two other readings that can be generated in LMax and SMax: (i) any group of boys with a cardinality less than 4 can, in general, lift that piano together (see (14a)); (ii) the maximal number n such that in general, n boys can together lift that piano is less than 4 (see (14b)). While it is doubtful whether (14a) is an available reading of the sentence, the reading (14b) is certainly unavailable.

(14) Two other readings of *fewer than 4 boys can together lift that piano*:
a. $\forall_{\text{GEN}} x[|x| < 4 \wedge \textsc{boys}(x) \rightarrow \textsc{can-lift-the-piano-together}(x)]$
(Either max takes a narrow scope within *fewer than 4 boys* or it is not used at all.)
b. $\mathsf{max}(\lambda n.\forall_{\text{GEN}} x[|x| = n \wedge \textsc{boys}(x) \rightarrow \textsc{can-lift-the-piano-together}(x)) < 4$
(max takes a wide scope over the rest of the sentence.)

Second, since the accounts of LMax and SMax rely heavily on a pragmatic rule that targets specifically the use of numerals (see (9)), these accounts fail to relate the pattern shown in (3) with some other data discussed in the semantics literature. Solt (2007) has noticed that the use of *few* interacts with the type of predicates in affecting the grammaticality of sentences. As shown in (15) and (16), the DE quantifier *few* is compatible with distributive predicates, but incompatible with collective predicates. Moreover, Solt (2007) has pointed out that to express the notion of a small quantity in sentences containing collective predicates, *a few* should be used, instead of *few*, as illustrated by the contrast between (16) and (17). Intriguingly, when we compare (15) and (17), the attested readings show exactly the same pattern as in (3). Obviously, a unified account that can explain both the patterns with the use of **non-increasing modified numerals** and with the use of ***few/a few*** would be more favorable, and this kind of accounts cannot rely on rules constraining the interpretation of numerals, because no numeral is involved in (15) – (17).

(15) Few boys smiled. *few* + **distributive** predicate
a. ✓ **Upper-bound reading** b. # **Existential entailment**

(16) *Few boys lifted the piano together. Ungrammatical: *few* + **collective** predicate

(17) A few boys lifted the piano together. *a few* + **collective** predicate
a. # **Upper-bound reading** b. ✓ **Existential entailment**

Third, as already discussed by Buccola and Spector (2016), the over-generation approach makes wrong predictions on NPI (negative polarity item) licensing. As shown in (18), NPI licensing is possible in (18a), suggesting that *fewer than 4 boys* is involved in creating a DE environment when combined with a distributive predicate; in contrast, NPI licensing is impossible in (18), suggesting that no DE environment is created when *fewer than 4 boys* combines with a collective predicate. This kind of contrast should be unexpected if there were indeed an over-generation mechanism underlying the interpretation of modified numerals. Actually, these data on NPI licensing suggest that some part of the semantic contribution of *fewer than 4 boys* (e.g., in creating a DE environment) is initially unspecified, but later determined by the type of predicates it combines with.[7]

(18) NPI licensing:
a. Fewer than 4 boys ate **any** soup. **Distributive** predicate ⇝ NPI licensing ✓
b. *Fewer than 4 boys surrounded **any** table.
Collective predicate ⇝ NPI licensing #
c. Fewer than 4 boys surrounded a table.

Fourth, there is an important factor overlooked by Buccola and Spector (2016): whether the noun that combines with a non-increasing modified numeral is a **group noun** (e.g., *army*, *team*, *committee*) or a **non-group noun** (e.g., *boy*, *dog*). Therefore, their accounts fail to fully characterize the exact mechanism that governs the semantic composition between distributive / collective predicates and the rest part of sentences. As (19) illustrates, even though here the predicate is collective, the sentence has an upper-bound reading (i.e., it is false if 4 or more than 4 groups of boys lifted the piano together), but no existential entailment (i.e., it is compatible with a situation in which no groups of boys lifted the piano together after all). Moreover, (20) shows that NPI licensing is possible here despite the use of a collective predicate (cf. (18b)). These data show that the interpretation of '[[DE modified numeral + **group** noun] + collective predicate]' is parallel to that of '[[DE modified numeral + **non-group** noun] + distributive predicate]', suggesting that the notion of group should also be taken into consideration.

(19) Fewer than 4 groups of boys lifted the piano together. **collective** predicate
a. ✓ **Upper-bound reading** b. # **Existential entailment**

(20) Fewer than 4 groups of soldiers surrounded any castle. ⇝ NPI licensing ✓

[7] This might be unsurprising if we reflect on the role the type of predicates plays in specifying actual interpretations in other cases. For example, (i) in *John and Mary left*, where the predicate is distributive, [[John and Mary]] is essentially $\lambda P.[\text{John} \sqcap \text{Mary}(P)]$, i.e., a set intersection, while in (ii) *John and Mary built a raft together*, where the predicate is collective, [[John and Mary]] essentially denotes $[\text{John} \oplus \text{Mary}]_e$, i.e., a sum (or a group). See Zhang (2015); Champollion (2016), etc., that deal with this issue and give the semantics of coordination a unified account.

Finally, conceptually, according to LMax and SMax, *fewer than n* is analyzed as a generalized quantifier of degrees, and its type is $\langle dt, t\rangle$. As a consequence, it remains unclear how to extend this analysis of *fewer than n* to further derive the meaning of *no fewer than n* (see (21)).[8]

(21) No fewer than 4 boys smiled. [[no fewer than 4]] ≈ [[at least 4]]

Overall, the discussion here provides motivation for a new account that (i) does not overgenerate, (ii) explains the parallelism between the interpretation pattern of *fewer than n* and (*a*) *few*, (iii) makes use of the notion of *group*, and (iv) avoids analyzing *fewer than n* as a generalized quantifier.

3. A new account à la Brasoveanu (2013)

Following Brasoveanu (2013), here I propose a post-supposition-style account for the semantics of non-increasing modified numerals, and implement my analysis in Brasoveanu (2013)'s modified version of Dynamic Predicate Logic (DPL, Groenendijk and Stokhof 1991). Brasoveanu (2013)'s version of DPL is slightly different from Groenendijk and Stokhof (1991)'s in two ways: (i) its ontology includes both **atomic** (e.g., *John*) and **non-atomic individuals** (e.g., *John and Bill*, *the men*); (ii) it makes a distinction between **at-issue meaning** and **a secondary dimension of meaning** and implements the latter as **post-suppositions**. In the following, I first introduce Brasoveanu (2013)'s framework and analyze sentences of the pattern 'DE modified numeral + distributive predicate' (Section 3.1). Based on this, I introduce the concept of **group** and account for sentences of the pattern 'DE modified numeral + collective predicate' (Section 3.2). I discuss more data (e.g., *between 4 and 8*) in Section 3.3 and some consequences in later sections.

3.1. The framework of Brasoveanu (2013) and the semantics of *fewer than 4 boys smiled*

The goal of Brasoveanu (2013) is to analyze the **cumulative** reading of sentence (22), and his basic idea includes two parts. First, the interpretation of '*exactly* n + NP' follows an existing generalization: unlike **bare numerals** (e.g., *4 boys*), **modified numerals** introduce **maximal referents** (see Szabolcsi (1997); de Swart (1999); Krifka (1999); Umbach (2006); Charlow (2014), etc). As illustrated in (23), to use *other boys* felicitously, its antecedent needs to be a contextually non-maximal referent. Thus, the incompatibility between *at least 4 boys* and *other boys* indicates that *at least 4 boys* introduces a maximal referent. Second, Brasoveanu (2013) proposes that the cardinality constraint contributed by modified numerals involves a secondary dimension of meaning (cf. at-issue meaning). To a certain extent, this is reminiscent of the semantic contribution of non-restrictive relative clauses (see the paraphrase in (22)). This secondary dimension of meaning is implemented as **post-suppositions** in a DPL framework by Brasoveanu (2013).

[8] Geurts and Nouwen (2007) have also argued that *more than n* should not be analyzed as a generalized quantifier.

(22) Exactly 3 boys saw exactly 5 movies. **Cumulative** reading
$\rightsquigarrow$ The contextually maximal set of boys, the cardinality of which is exactly 3, saw the contextually maximal set of movies, the cardinality of which is exactly 5.

(23) a. At least 4 boys smiled. (# Perhaps there were other boys smiling, but I forgot.)
b. Four boys smiled. (✓ Perhaps there were other boys smiling, but I forgot.)

The central idea of DPL is to analyze sentential meanings as **information change potential** (i.e., ways of changing (the representation of) the information of the interpreter), instead of truth conditions (Groenendijk and Stokhof 1991). Thus, the meaning of a sentence can be captured in terms of a relation between states. For our current purpose, it is analyzed as a pair of **assignment functions**.

Following Brasoveanu (2013), my DPL models have the structure $\mathfrak{M} = \langle \mathfrak{D}, \mathfrak{I} \rangle$, in which $\mathfrak{D}$ is the domain of individuals, and $\mathfrak{I}$ is the basic interpretation function such that $\mathfrak{I}(R) \subseteq \mathfrak{D}^n$, for any n-ary relation R. The domain $\mathfrak{D}$ consists of **atomic** and **non-atomic individuals**. **Atomic individuals** are singleton sets, e.g., $\{\textsc{John}\}$; **non-atomic individuals** are sets with a cardinality larger than 1, e.g., $\{\textsc{John}, \textsc{Bill}\}$. I also include the empty set $\varnothing$ in $\mathfrak{D}$. The **cardinality** of an individual x, written as $|x|$, means the count of its singleton subsets. The **sum** of two individuals $x \oplus y$ is the union of the sets x and y, e.g., $\{\textsc{John}\} \oplus \{\textsc{Bill}\} = \{\textsc{John}, \textsc{Bill}\}$. The **part-of relation** over individuals $x \leq y$ means that x is a part of y, and formally it means that $x \subseteq y$. For any property P, the **cumulative closure** $*P$ is the smallest set such that $P \subseteq *P$ and if individuals $a, a' \in *P$, then $a \oplus a' \in *P$.

An **assignment function** g is a total function from the set of variables $\mathcal{V}$ to $\mathfrak{D}$. Sentence meanings are modeled as $\langle g, h \rangle$, i.e., a pair of assignment functions, in which g represents the current information state, and h the updated state. $h[x]g$ means that for any variable $v \in \mathcal{V}$, if $v \neq x$, then $h(v) = g(v)$, i.e., h differs from g at most with regard to the value it assigns to the variable x.

As shown in (24a), atomic formulas for lexical relations are **tests** (only unary relations, i.e., properties, are shown in this paper), i.e., the input and output assignment functions g and h are equal and the value of certain variables is checked. Cardinality constraints are tests as well, as illustrated in (24b) with the use of '='. Dynamic conjunction and random assignment are shown in (24c) and (24d). (25a) shows an example, in which the introduced discourse referent is marked in green, the restrictor in red and the nuclear scope in blue, and it can be decomposed in the way shown in (25b).

(24) a. $[\![P(x)]\!]^{\langle g,h \rangle} = \mathbb{T}$ iff $g = h$ and $h(x) \in *\mathfrak{I}(P)$. **Atomic formula**
b. $[\![|x| = n]\!]^{\langle g,h \rangle} = \mathbb{T}$ iff $g = h$ and $|h(x)| = n$. **Cardinality constraint**
c. $[\![\phi \wedge \psi]\!]^{\langle g,h \rangle} = \mathbb{T}$ iff there is a k s.t. $[\![\phi]\!]^{\langle g,k \rangle} = \mathbb{T}$ and $[\![\psi]\!]^{\langle k,h \rangle} = \mathbb{T}$. **Dynamic conjunction**
d. $[\![[x]]\!]^{\langle g,h \rangle} = \mathbb{T}$ iff $h[x]g$. **Random assignment**

(25) a. $[\![\text{A}^x \text{ wolf came in}]\!] \Leftrightarrow \exists x[|x| = 1 \wedge *\textsc{wolf}(x)](*\textsc{come-in}(x))$

b. $\exists x[|x| = n \wedge \phi](\psi) := [x] \wedge |x| = n \wedge \phi \wedge \psi$ $[x]$: storing a discourse referent (dref)

Brasoveanu (2013)'s maximization operator σ introduces a maximal referent (see (26)). As (27) illustrates, basically, here x stores **all** the atomic entities that satisfy the restrictor and nuclear scope.

(26) $[\![\sigma x(\phi)]\!]^{\langle g,h\rangle} = \mathbb{T}$ iff **Maximization operator σ**
(i) $[\![[x] \wedge \phi]\!]^{\langle g,h\rangle} = \mathbb{T}$ and (ii) there is no h' such that $[\![[x] \wedge \phi]\!]^{\langle g,h'\rangle} = \mathbb{T}$ and $h(x) < h'(x)$.

(27) $[\![\text{Exactly three}^x \text{ wolves came in}]\!] \Leftrightarrow \exists|x| = 3[*\textsc{wolf}(x)](*\textsc{come-in}(x))$
$\Leftrightarrow \sigma x(*\textsc{wolf}(x) \wedge *\textsc{come-in}(x)) \wedge |x| = 3$ (The post-supposition part is to be revised.)

In Brasoveanu (2013), post-suppositions are implemented as **tests on the output context**, i.e., they are introduced at certain points in meaning derivation, but checked after the at-issue meaning of a formula is evaluated. Thus, tests need to be added into our representation of input and output states, and the meaning of a sentence is written as $\langle g[\zeta], h[\zeta']\rangle$, where g and h are assignment functions, and ζ and ζ' are (possibly empty) sets of tests such that $\zeta \subseteq \zeta'$. As (28) shows, a post-supposition ϕ does not update the input assignment function g; it is only added into the input set of tests ζ. Based on this, some adjustments are made in defining DPL concepts, as shown in (29).

(28) $[\![^{\phi}]\!]^{\langle g[\zeta],h[\zeta']\rangle} = \mathbb{T}$ iff ϕ is a test, $g = h$ and $\zeta' = \zeta \cup \{\phi\}$ **Post-supposition ϕ**

(29) a. ϕ is **true** relative to an input context $g[\varnothing]$ ($\varnothing$ is an empty set) iff there is an output assignment h and a (possibly empty) set of tests $\{\psi_1, ..., \psi_m\}$ such that
(i) $[\![\phi]\!]^{\langle g[\varnothing],h[\{\psi_1,...,\psi_m\}]\rangle} = \mathbb{T}$ and (ii) $[\![\psi_1 \wedge ... \wedge \psi_m]\!]^{\langle h[\varnothing],h[\varnothing]\rangle} = \mathbb{T}$. **Truth**

b. $[\![P(x)]\!]^{\langle g[\zeta],h[\zeta']\rangle} = \mathbb{T}$ iff $g = h$, $\zeta = \zeta'$ and $h(x) \in *\Im(P)$. **Atomic formula as test**

c. $[\![\phi \wedge \psi]\!]^{\langle g[\zeta],h[\zeta']\rangle} = \mathbb{T}$ **Dynamic conjunction**
iff there is a k and a ζ'' such that $[\![\phi]\!]^{\langle g[\zeta],k[\zeta'']\rangle} = \mathbb{T}$ and $[\![\psi]\!]^{\langle k[\zeta''],h[\zeta']\rangle} = \mathbb{T}$.

d. $[\![[x]]\!]^{\langle g[\zeta],h[\zeta']\rangle} = \mathbb{T}$ iff $h[x]g$ and $\zeta = \zeta'$. **Random assignment**

e. $[\![\sigma x(\phi)]\!]^{\langle g[\zeta],h[\zeta']\rangle} = \mathbb{T}$ iff (i) $[\![[x] \wedge \phi]\!]^{\langle g[\zeta],h[\zeta']\rangle} = \mathbb{T}$ **Maximization operator σ**
and (ii) there is no h' such that $[\![[x] \wedge \phi]\!]^{\langle g[\zeta],h'[\zeta']\rangle} = \mathbb{T}$ and $h(x) < h'(x)$.

Finally, to analyze the distributive reading of sentences, I also follow Brasoveanu (2013) and define a distributivity operator δ. As shown in (30), when we distributively interpret a formula ϕ relative to a plural individual $g(x)$, we check that ϕ is satisfied by each atom a that is a part of $g(x)$.[9] The (ii) part of this definition means that the distributivity operator δ discharges all the post-suppositions contributed by ϕ within its scope. Thus distributivity is externally static.

[9]This is rather a simplified picture. Basically, $\delta x(\phi)$ is treated as a test here, and I don't consider any quantificational dependencies introduced by or within the scope of δ. Things become much more complicated for this kind of example: *Every year, John wrote a longer novel, which is about 50 pages longer than the previous one* (See Bumford 2015).

(30) $[\![\delta x(\phi)]\!]^{\langle g[\zeta], h[\zeta']\rangle} = \mathbb{T}$ iff $g = h$, $\zeta = \zeta'$, and for all atoms $a \leq g(x)$, if we let g' be such that $g'[x]g$ and $g'(x) = a$, then there is a k and a (possibly empty) set of tests $\{\psi_1, ..., \psi_m\}$ such that (i) $[\![\phi]\!]^{\langle g'[\zeta], k[\zeta \cup \{\psi_1, ..., \psi_m\}]\rangle} = \mathbb{T}$ and (ii) $[\![\psi_1 \wedge ... \wedge \psi_m]\!]^{\langle k[\zeta], k[\zeta]\rangle} = \mathbb{T}$

On the base of this DPL framework developed by Brasoveanu (2013), the semantics of sentences of the pattern 'DE modified numeral + distributive predicate' can be accounted for straightforwardly.

(31) $[\![$Fewer than 4^x boys smiled$]\!] \Leftrightarrow \exists^{|x|<4}[*\textsc{boys}(x)]\delta(*\textsc{smile}(x))$
$\Leftrightarrow \sigma x(*\textsc{boy}(x) \wedge \delta x(*\textsc{smile}(x)))\wedge^{|x|<4}$
$\Leftrightarrow \sigma x(*\textsc{boy}(x) \wedge \delta x(*\textsc{smile}(x))) \wedge |x| < 4$
i.e., the maximal set x such that (i) it consists of boys and (ii) each atomic part of x smiled has a cardinality smaller than 4.[10]

As shown in (31), both the predicates in the restrictor and nuclear scope are distributive, thus the at-issue meaning contributed by modified numerals, i.e., the maximization operator, takes scope over the whole sentence. On the base of this, the cardinality constraint is evaluated as a second dimension of meaning, and thus *fewer than 4* has the effect of taking a pseudo wide scope over the whole sentence, resulting in the upper-bound reading. Notice that I have also included the empty set $\varnothing$ in the domain $\mathfrak{D}$, thus it is not guaranteed that the introduced maximal referent is a non-empty set, which accounts for our intuition that this sentence has no existential entailment.[11]

3.2. The notion of group and the semantics of *fewer than 4 boys lifted the piano together*

Following Barker (1992) (see also Schwarzschild 1996; Winter 2001; Champollion 2010), I consider **groups** a special kind of **atomic individuals**. E.g., *a certain committee constituted by John and Bill* means a singleton set, and I write it as $\uparrow\{\textsc{John}, \textsc{Bill}\}$ in the following. In fact, the atoms of an individual X (i.e., the singleton subsets of a non-empty set X) can form many different groups, depending on context. E.g., the atoms of $\{\textsc{John}, \textsc{Bill}\}$ (i.e., $\{\textsc{John}\}$ and $\{\textsc{Bill}\}$) can form a beach volleyball team, a jazz duo, a job search committee, etc. Therefore, $\uparrow$ can be considered an operator that is the function composition of (i) a context-dependent **choice function** and (ii) a **group-generating operator** that takes a non-empty set X as input and returns the set containing all the groups constituted by the atoms in X. As a consequence, for $\uparrow X$ to be well-defined, X needs to be a non-empty set. Moreover, the operator $\uparrow$ is externally static, i.e., any secondary-dimension meaning introduced within the scope of $\uparrow$ needs to be discharged therein.

As (32) illustrates, there is an interaction between the type of nouns and predicates: group nouns are compatible with collective predicates, but incompatible with distributive predicates;

[10] Obviously, the maximal referent introduced by modified numerals can be an infinite set, and sentences such as *fewer than 5^x prime numbers are odd* cause no problems (cf. Buccola and Spector 2016, see also Footnote 4).

[11] However, in *Fewer than 4^x boys smiled; they^x solved all the problems*, the use of *they* – a refset anaphora (see Charlow 2014) referring to the boys who smiled – brings the presupposition that the maximal referent introduced previously has a cardinality above zero, and its interpretation fails if the accommodation of presupposition fails.

while the pattern with non-group nouns is exactly the opposite.[12] Thus, I assume the meaning postulates shown in (33) for these predicates: basically, they all require their agents be atomic individuals, but more specifically, distributive and collective predicates have complementary requirements. The upshot here is that the agent of *lift the piano together*, a collective predicate, has to be a group. Based on this, the semantics of sentences of the pattern 'DE modified numeral + collective predicate' can also be accounted for straightforwardly, as shown in (34).

(32) The interaction between the type of nouns and predicates:
a. * Every soldier formed a circle. b. ✓ Every soldier smiled.
c. ✓ Every army formed a circle. d. * Every army smiled.

(33) Meaning postulates for distributive and collective predicates:
a. *Smile* requires its agent be a **non-group atomic individual**.
b. *Form a circle* and *lift the piano together* require their agent be a **group**.

(34) [[Fewer than 4^x boys^Y lifted the piano together]] $\rightsquigarrow$ *a fewer-than-4-boy group*
$\Leftrightarrow \exists Y[Y = \uparrow [[\text{fewer than } 4^x \text{ boys}]]](*\textsc{lift-the-piano-together}(Y))$
$\Leftrightarrow [Y] \wedge Y = \uparrow \{i \in x | \sigma x(*\textsc{boy}(x)) \wedge^{|x|<4}\} \wedge *\textsc{lift-the-piano-together}(Y)$ (see (25b))
$\Leftrightarrow [Y] \wedge Y = \uparrow \{i \in x | \sigma x(*\textsc{boy}(x)) \wedge |x| < 4\} \wedge *\textsc{lift-the-piano-together}(Y)$
i.e., a group of boys, the total number of which is smaller than 4, lifted the piano together.

In (34), Y stores a dref, which has to be a group, and here *fewer than 4 boys* provides some description for this dref, i.e., it consists of a set of boys, the cardinality of which is smaller than 4.[13] Evidently, the dref Y is not within the scope of any maximization operator, indicating that the meaning of the sentence is compatible with situations in which there are other groups, and thus there is no upper-bound reading for this sentence. Moreover, since $\uparrow$ requires its input set be non-empty, it is guaranteed that there are some boys, thus deriving the existential entailment.

To sum up, Sections 3.1 and 3.2 together account for the generalization shown in (3). The semantic contribution of *fewer than 4* remains constant, and there is no over-generation. In addition, each and every part of the proposed analysis here has been motivated independently in the literature.

3.3. Extensions of the current proposal

Between 4 and 8 The data in (4) show that sentences containing *between 4 and 8* pattern with those containing *fewer than 4* with regard to whether there is an upper-bound reading. This

[12]As pointed out by Barker (1992), expressions such as *the group of boys* is ambiguous between two readings: (i) group-as-individual, and (ii) group-as-set. Obviously, under the group-as-set interpretation, *the group of boys smiled* is a grammatical and felicitous sentence. I use **group** to mean Barker (1992)'s group-as-individual and treat groups as atomic individuals, and I use **non-atomic individual** to mean Barker (1992)'s group-as-set (see Section 3.1).

[13]This 'a fewer-than-4-boy group' analysis is somehow reminiscent of the contrast between (15) and (17): ***few** boys* is used along with distributive predicates, while ***a few** boys* is used along with collective predicates.

can be accounted for straightforwardly: in (35b), the predicate is collective, and *between 4 and 8 boys* refers to a group. Crucially, there is no maximization operator to limit the number of groups.

(35) a. [[Between 4 and 8^x boys smiled]] $\Leftrightarrow \sigma x(*\textsc{boy}(x) \wedge \delta x(*\textsc{smile}(x))) \wedge |x| \in [4,8]$

b. [[Between 4 and 8^x boys^Y lifted the piano together]]
$\Leftrightarrow [Y] \wedge Y =\uparrow \{i \in x | \sigma x(*\textsc{boy}(x)) \wedge |x| \in [4,8]\} \wedge *\textsc{lift-the-piano-together}(Y)$

The use of group nouns As shown in the meaning postulates (33), both distributive and collective predicates require their agents be atomic individuals, but collective predicates specifically require their agents be groups. Obviously, this straightforwardly explains why the interpretation of '[[modified numeral + group noun] + collective predicate]' is parallel to that of '[[modified numeral + non-group noun] + distributive predicate]'. As illustrated in (36), here the collective predicate *surround the castle* distributes over groups (here *armies*), leading to an upper-bound reading.

(36) [[Fewer than 4^Y armies surrounded the castle]]
$\Leftrightarrow \sigma Y(*\textsc{army}(Y) \wedge \delta Y(*\textsc{surround-the-castle}(Y))) \wedge |Y| < 4$

Few / a few In the current account, nothing hinges on the numeral in modified numerals. Thus, sentences containing *few / a few* can be analyzed in the same way, simply by replacing the numeral in modified numerals with a context-sensitive threshold value of largeness, as illustrated in (37).

(37) a. [[Few^x boys smiled]] $\Leftrightarrow \sigma x(*\textsc{boy}(x) \wedge \delta x(*\textsc{smile}(x))) \wedge |x| < \textsc{Threshold}^{\textsc{Context}}$

b. [[A few^x boys^Y lifted the piano together]]
$\Leftrightarrow [Y] \wedge Y =\uparrow \{i \in x | \sigma x(*\textsc{boy}(x)) \wedge |x| < \textsc{Threshold}^{\textsc{Context}}\} \wedge *\textsc{lift-the-piano-together}(Y)$

No fewer than 4 The current account can also be extended to give a compositional analysis for *no fewer than 4* (e.g., *no fewer than 4 boys smiled*). Similar to other modified numerals, *no fewer than 4* also (i) introduces a maximal referent and (ii) adds a cardinality constraint as a secondary dimension of meaning. Evidently, only this cardinality part needs to be slightly modified.

In the same spirit as Szabolcsi (1997); Geurts and Nouwen (2007), etc., which have pointed out that modified numerals provide quantity information and should not be analyzed as generalized quantifiers, here I follow Zhang and Ling (2015, 2017) and analyze this kind of quantity information in terms of intervals. Intervals are convex sets of degrees, and thus their type is $\langle dt \rangle$. We can write an interval – $\lambda\delta_d.\{\delta | D_{\text{lower-bound}} \leq \delta \leq D_{\text{upper-bound}}\}$ – in terms of its upper- and lower-bounds: $[D_{\text{lower-bound}}, D_{\text{upper-bound}}]$. An interval represents a range of possible values on a scale. In a certain sense, we can consider $(3,5)$ a vaguer value than $[4,5]$ or a singleton set $[4,4]$, because $(3,5)$ contains more possibilities. The operations on intervals are defined on the base of this idea (see Moore 1979). The compositional details of deriving the cardinality part of *(no) fewer than 4* are shown in (38). Notice that in (38e), I analyze the meaning of *no* as an operator on sets: it takes a set as input and returns its complement. As shown in (38f), the cardinality part of *no fewer than 4* is basically equivalent to what *at least 4* means, which is consistent with our intuition.

(38) The cardinality part of *(no) fewer than 4* is analyzed as a set of degrees of type $\langle dt \rangle$:
a. $[\![4]\!]_{\langle dt \rangle} \overset{\text{def}}{=} [4,4]$ I.e., a singleton set of degrees
b. $[\![\text{fewer}]\!]_{\langle dt \rangle} \overset{\text{def}}{=} (-\infty, 0)$ I.e., a set denoting a differential of negative value
c. $[\![\text{than}]\!]_{\langle dt,\langle dt,dt \rangle\rangle} \overset{\text{def}}{=} \lambda I_{\text{Comp.-Standard}}.\lambda I_{\text{Differential}}.\iota I_{\text{Comp.-Subj.}}[I_{\text{Comp.-Subj.}} - I_{\text{Comp.-Standard}} = I_{\text{Differential}}]$
d. $[\![\text{fewer than 4}]\!]_{\langle dt \rangle} = \iota I.[I - [4,4] = (-\infty, 0)] = (-\infty, 4)$
(Interval subtraction: $[x_1, x_2] - [y_1, y_2] = [x_1 - y_2, x_2 - y_1]$) (see Moore 1979)
e. $[\![\text{no}]\!]_{\langle dt,dt \rangle} \overset{\text{def}}{=} \lambda I.\iota I'[I' = (-\infty, +\infty) \setminus I]$
f. $[\![\text{no fewer than 4}]\!]_{\langle dt \rangle} = \iota I'[I' = (-\infty, +\infty) \setminus (-\infty, 4)] = [4, +\infty)$

Fewer than 4 boys can together lift that piano The generic reading of this sentence (see also Section 2.1) is derived in (39), with the assumption of a silent genericity operator $\forall_{\text{Gen}}$ binding Y.

(39) $[\![\text{Fewer than } 4^x \text{ boys}^Y \text{ can together lift that piano}]\!]$
$\Leftrightarrow \forall_{\text{Gen}}[\![\text{Fewer than } 4^x \text{ boys}^Y]\!][\![\text{can together lift that piano}]\!]$
$\Leftrightarrow \forall_{\text{Gen}} Y[Y =\uparrow \{i \in x | \sigma x(*\textsc{boy}(x)) \wedge |x| \in (-\infty, 4)\} \rightarrow \diamond *\textsc{together-lift-that-piano}(Y)]$
I.e., in general, boy groups of a cardinality smaller than 4 can together lift that piano.

Crucially, the sentence meaning derived in (39) does not entail that boy groups of any cardinality smaller than 4 can together lift that piano. As I have mentioned above, $(-\infty, 4)$ means a range of possible values, and thus it provides quantity information in a vague way. Therefore, the effect of using the information '*fewer than 4 boys*' in describing a group is analogous to the effect of describing a dish as *meat stew*: *meat stew* contains some kind of meat, but not any kind of meat, and due to our world knowledge, the possibility of, say, dinosaur meat, is certainly very improbable.

In sum, the data discussed in Section 3.3 can all be easily accounted for, which provides more empirical support for the current proposed account for modified numerals.

4. Sentences with a cumulative (or co-distributive) reading

Brasoveanu (2013) and Buccola and Spector (2016) approach cumulative-reading sentences differently. In Brasoveanu (2013)'s analysis of sentence (22) (repeated here as (40)), the same maximization operator globally binds both the variables x and y, introducing simultaneously two maximal sets. A consequence of this is that when there is a DE modified numeral, it is predicted that there is an upper-bound reading, but no existential entailment. The examples in (41) suggest that this prediction is borne out. On the other hand, according to Buccola and

Spector (2016)'s account for sentence (42), the predicate here is considered a collective one, and thus, the sentence has an existential entailment, but no upper-bound reading. Both cases can be handled by the current proposed analysis. However, there is a remaining issue for future research. For this kind of sentences containing multiple (modified) numerals, what factors determine their interpretation? Can there be examples showing a true ambiguity? Are animacy and agent/theme asymmetry involved here?

(40) Exactly 3^x boys saw exactly 5^y movies. **Cumulative** reading
$\sigma xy(*\textsc{boy}(x) \wedge *\textsc{movie}(y) \wedge *\textsc{see}(x,y)) \wedge |y| = 5 \wedge |x| = 3$

(41) These 10^x chickens laid <u>fewer than 20^y eggs</u> in total. ✓ Upper-bound; # Existential
<u>Fewer than 20^y eggs</u> were laid by these 10^x chickens. ✓ Upper-bound; # Existential
$\sigma xy(*\textsc{chicken}(x) \wedge *\textsc{egg}(y) \wedge *\textsc{lay}(x,y)) \wedge |y| < 20 \wedge |x| > 10$
(cf. <u>Fewer than 10 chickens</u> laid 20 eggs in total. # Upper-bound; ✓ Existential)

(42) Fewer than 4^x boys^Y drank 20 beers between them. # Upper-bound; ✓ Existential
$[Y] \wedge Y = \uparrow \{i \in x | \sigma x(*\textsc{boy}(x)) \wedge |x| < 4\} \wedge *\textsc{drink-20-beers-between-them}(Y)$
(cf. 4 boys drank <u>fewer than 20 beers</u> between them. ✓ Upper-bound; # Existential)

5. Buccola and Spector (2016)'s 'informativity-based maximality' approach

Buccola and Spector (2016) has also proposed an approach of informativity-based maximality. The basic idea is that for a degree n to be P-maximal in w, it satisfies two requirements: (I) the proposition $P(n)$ must be true in w, and (II) there is no degree m such that (i) $P(m)$ is true in w and (ii) $P(m)$ is more informative than $P(n)$. This idea is formally implemented as a $\mathsf{max}_{\text{inf}}$ operator, and there are two specific analyses: **L**(exical)**Max$_{\text{inf}}$** (see (43)) and **S**(eparate)**Max$_{\text{inf}}$**.

(43) a. $[\![\text{fewer than}]\!]^w \stackrel{\text{def}}{=} \lambda n_d.\lambda P_{\langle s,\langle dt\rangle\rangle}.\exists m[m < n \wedge \mathsf{max}_{\text{inf}}(P)(w)(m)]$ LMax$_{\text{inf}}$
b. $[\![\text{fewer than 4}]\!]^w \stackrel{\text{def}}{=} \lambda P_{\langle s,\langle dt\rangle\rangle}.\exists m[m < 4 \wedge \mathsf{max}_{\text{inf}}(P)(w)(m)]$

This 'informativity-based maximality' approach has at least the following four problems, and the first two have already been mentioned and discussed in Buccola and Spector (2016). **(I)** First, scope interactions between a modified numeral and an existential closure still cause over-generation. Using a pragmatic rule like (9) can sometimes rule out some unattested readings, but, as I have discussed in Section 2.2, the use of this pragmatic rule has its own problems. **(II)** Second, although this approach naturally accounts for the (un)availability of upper-bound readings, there are non-trivial complications with regard to accounting for the (un)availability of existential entailment. Some stipulations are added in Buccola and Spector (2016) to deal with this issue. **(III)** Third, given semantic compositionality, a good account for the semantics of *fewer than 4* should be able to be extended to account for the semantics of *no fewer than 4*. However, LMax$_{\text{inf}}$ cannot achieve this. Roughly speaking, in combining *no* with *fewer than (4)* to derive the semantics of *no fewer than 4*, since the part $\mathsf{max}_{\text{inf}}(P)(w)(n)$ in (43) should intuitively remain constant for both *fewer than 4* and *no fewer than 4*, it is unclear how *no* targets only the part $m < n$ or $m < 4$. **(IV)** Fourth, if SMax$_{\text{inf}}$ is adopted, i.e., $\mathsf{max}_{\text{inf}}$ is independent of the semantics of modified numerals, then it raises the question why $\mathsf{max}_{\text{inf}}$ cannot be used in sentences containing bare numerals. If it is used, then since informativity-based maximality is now part of the truth conditions of sentences, in a situation where I ate 4 apples, the sentence *I ate 3 apples* is simply false, not under-informative.

However, there are another set of relevant data that seem to motivate the approach of informativity-based maximality (see Buccola 2015a; Buccola and Spector 2016), namely sentences expressing different scalarity entailment. E.g., from *fewer than* <u>*10*</u> *eggs can feed these people*, it follows that *fewer than* <u>*11*</u> *eggs can feed these people*, but from *fewer than* <u>*10*</u> *people can fit into this elevator*, it follows that *fewer than* <u>*9*</u> *people can fit into this elevator*. Whether the current proposed analysis can be extended to account for this kind of inference pattern is left for future research.

6. Brasoveanu (2013)'s approach vs. Solt (2006)'s 'decomposition + split scope' analysis

Solt (2006) has proposed a 'decomposition + split scope' account for *few*: *few* is decomposed into (i) a positive cardinality and (ii) a negation operator that takes the widest possible scope (see (44)).

(44) $[\![\text{few}]\!]_{\langle et\rangle} \overset{\text{def}}{=} \lambda x.[\textsc{large-value}^{\text{CONTEXT}}(|x|)]$; storing a negation operator

a. [[**Few** students passed the test]]
$\Leftrightarrow \neg\exists x[\textsc{large-value}^{\text{CONTEXT}}(|x|) \wedge {*}\textsc{student}(x) \wedge {*}\textsc{pass-the-test}(x)]$ $\qquad \neg > \exists$

b. [[**A few** students passed the test]]
$[\![\text{A few students}]\!] = \lambda P_{\langle et\rangle}.\exists x[\neg\textsc{large-value}^{\text{CONTEXT}}(|x|) \wedge {*}\textsc{student}(x)]$ $\qquad \exists > \neg$

For sentences like *fewer than 4 boys lifted the piano together*, if we assume that there is also a silent existential closure within the subject DP (i.e., ***A*** *fewer-than-4-boy (group)*) and adopt a decompositional analysis à la Solt (2006), presumably the existential entailment and the lack of an upper-bound reading of this sentence can also be accounted for. Compared with Brasoveanu (2013)'s approach, Solt (2006)'s seems to have some disadvantages and an advantage. First, Solt (2006) cannot address the maximal reference issue. Second, in terms of compositionality, *fewer than 4* cannot be derived from (i) negation and (ii) *larger than 4* – '*equal to 4*' needs to be ruled out (see Zhang and Ling 2017). However, it seems that within the current proposed analysis, modified numerals like *fewer than 4* and *no fewer than 4* are analyzed in the same way (see Section 3.3), which raises the question of how to account for NPI licensing. This is also left for future research.

7. Summary and outlook

In this paper, based on existing well-motivated components of natural language semantics, I explain the interplay between (i) the interpretation of sentences containing non-increasing modified numerals and (ii) the type of predicates therein. In addition to what has been discussed in Sections 4 – 6, there are two remaining issues: (i) Whether there are other ways of implementing the secondary dimension of meaning of modified numerals, and whether/how they differ in terms of dynamicity/staticity; (ii) Whether/how the semantics of modified numerals interacts with modals.

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